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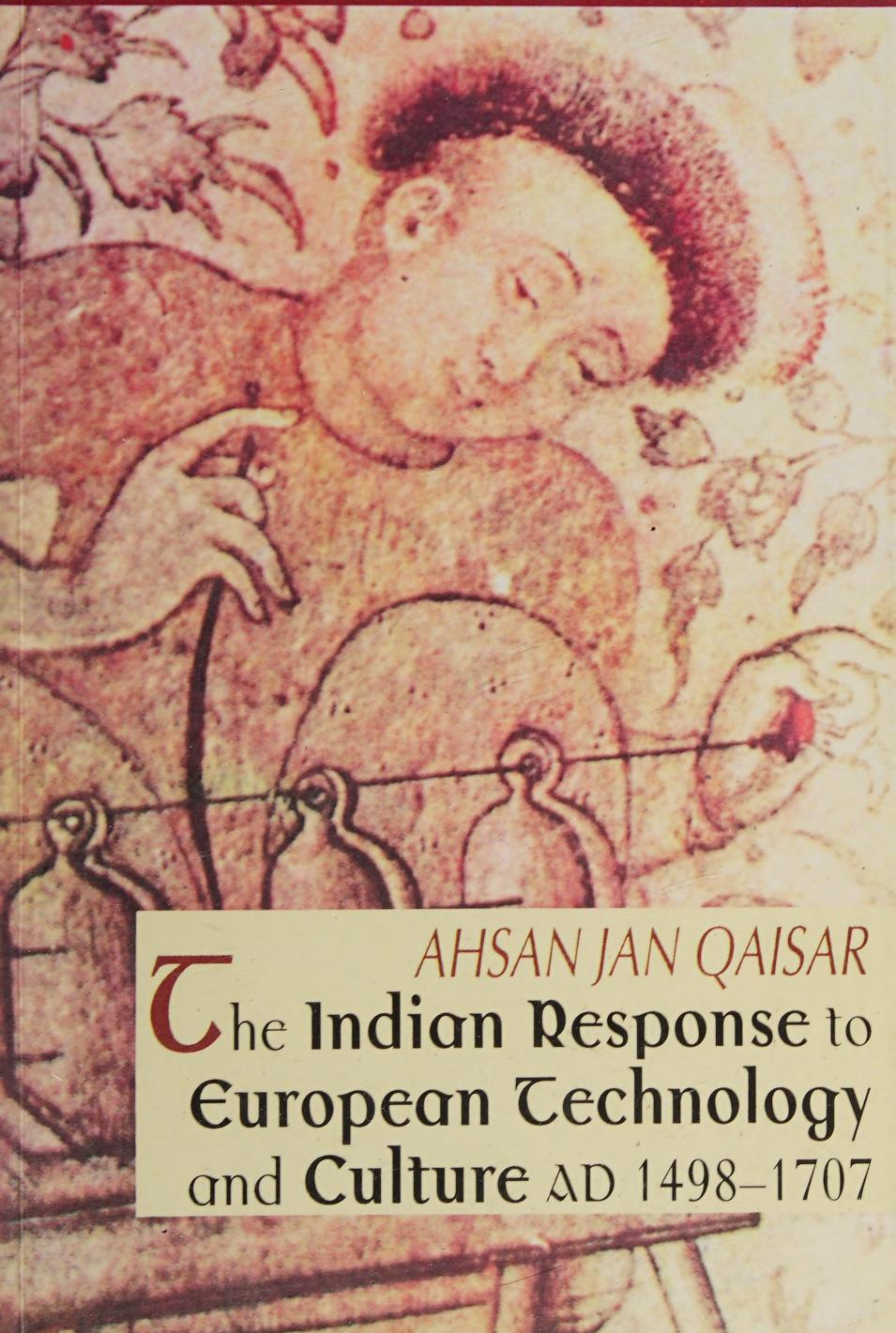

AHSAN JAN QAISAR

The Indian Response to European Technology and Culture AD 1498–1707

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THE INDIAN RESPONSE TO EUROPEAN TECHNOLOGY AND CULTURE

(A.D. 1498–1707)

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Dedicated
to
my father
MOULVI MOTIUR RAHMAN

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A. J. QAISAR

Aligarh
18 August 1981

NOTE ON TRANSLITERATION AND DIACRITICS

Scholars of Medieval India, specially those using Persian/Arabic sources, have not yet evolved a uniform pattern of transliteration and diacritics. I am no exception. Nonetheless, I have generally followed Steingass's celebrated *A Comprehensive Persian–English Dictionary*, though not consistently. For this I can offer no cogent explanation except that, in the Indian situation, Steingass's system struck me as too pedantic and cumbersome. For reasons of economy and other considerations, diacritics have been omitted from some place-names, generally those in South India, and, also, hard sounds have not been indicated (e.g. *kh* in *Khān* does not get a diacritical mark). In retrospect I regret having consistently used Abul Fazl rather than Abūl Fazl, the more correct form, and request readers to treat it as such. I sincerely hope that these departures from the 'norm'(?) will not inconvenience them.

ABBREVIATIONS

Ā'in	*Ā'in-i Akbarī*
Badauni	*Muntakhab-ut Tawārīkh*
BM	British Museum
BSOAS	*Bulletin of the School of Oriental and African Studies*
EF	*The English Factories in India*
IC	*Islamic Culture*
I.O.	India Office Library, London
IESHR	*Indian Economic and Social History Review*
IHR	*Indian Historical Review*
IJHS	*Indian Journal of the History of Science*
JAS (Bengal)	*Journal of the Asiatic Society* (Bengal)
JAS (Bombay)	*Journal of the Asiatic Society* (Bombay)
JBORS	*Journal of the Bihar and Orissa Research Society*
JEH	*Journal of Economic History*
JIH	*Journal of Indian History*
JRAS	*Journal of the Royal Asiatic Society*
Khamsa	*Khamsa-i Nizāmī*
MIQ	*Medieval India Quarterly*
MM	*Mariner's Mirror*
OA	(Department of) Oriental Antiquities
OHRJ	*The Orissa Historical Research Journal*
PIHC	*Proceedings of the Indian History Congress*
Purchas	*Purchas His Pilgrimes*
QRHS	*Quarterly Review of Historical Studies*
RAS (Bombay)	*Royal Asiatic Society* (Bombay)
SOAS	School of Oriental and African Studies, London
Tuzuk	*Tuzuk-i Jahāngīrī*
V&A	Victoria and Albert Museum, London.

INTRODUCTION

A momentous era began around A.D. 1498. The rounding of the Cape of Good Hope paved the way for tremendous changes in numerous directions in world history. From 1498 onwards, steady streams of Europeans reached Africa and Asia through this route. Lured by her wealth, 'coveted by the Emperors and Kings of the world',[1] they came to India as traders, missionaries, envoys, travellers, fortune-seekers and adventurers. India's response to this 'invasion' during the first two centuries of her contact with Europeans opens a fascinating and revealing area of study.

Attempts to study this 'confrontation' have been largely confined to its commercial, administrative and political impact.[2] Efforts directed towards an analytical study of the extent of European influence on the technological and cultural sectors of Indian society during the sixteenth and seventeenth centuries are yet inadequate.[3] Some studies have glibly dubbed Indian society of the past as 'static': a fantasy of a people impervious to innovation and change. In fact, the *cliché* of conservatism recurs at any and every opportunity. Consider, for instance, the following:

> Asian society, whether Indonesian, Chinese, Japanese, Indian, Persian or Malay, had no wish whatever to be changed by European contacts in the 17th and 18th centuries, but wished only to retain its traditional and static forms.[4]

and again, a recent passage from a Western scholar:

> The theology of Hinduism did not encourage the growth of rational thought, and the social system hindered technical innovation. In spite of extensive contact with foreigners, India did not copy foreign technology either in shipping or navigation or in artillery and military organisation, and this is one of the reasons it was conquered by Europeans.[5]

Such summary pontifications from a majority of Western scholars are echoed by some of their Indian counterparts who

have been hypnotized into approvingly accepting a term and a concept contemptuously used, and ubiquitously available, in the writings of Western social scientists, that is, *traditional society*. For example, one Indian scholar is extremely satisfied with his thesis that Hinduism, with all its implications—such as the caste system, other-worldliness, etc.—acted as a negative factor in economic growth. In one context he remarks: 'Nor was there any urge to create or even learn new techniques of production from the Europeans.'[6] In his opinion, this was due, among other factors, to the Indian attitude towards work—'lazy enjoyment', to be exact.[7] Again, another Indian scholar in an article merely assembles some of the oft-repeated shibboleths which, *inter alia*, includes the caste system, the Bhakti movement, theology-based curriculum and finally, important for our present study, the absence of social contact between Europeans and Indians, as factors for the low development of science and technology in Mughal India.[8]

There is yet another approach which has recently acquired some respectability in India. A hypothesis has been offered that the period before the twelfth century (A.D.) in India saw 'remarkable progress' in science and technology, but thereafter 'the creative endeavour showed signs of decay due to the traditional compulsions and political vicissitudes' (the 'traditional compulsions' denote the caste system, and 'political vicissitudes' refer to the coming of Muslims to India).[9] Thus, innovations were inhibited by a sense of 'insecurity' generated by Muslim rule until the Europeans rescued us.[10]

Besides theology, the caste system, social attitudes and lack of patronage,[11] some in search of reasons for the passive nature of Indian society have accorded a rather inflated role to geography, climate and diet. For instance:

> Breathing in the softest of climate, having so few real wants . . . the Indian must become the most effeminate inhabitant of the globe; and this is the very point at which we now see him.[12]

As a result:

> Two English sawyers have performed in one day the work of thirty-two Indians: allowances made for the difference of dexterity, and the advantage of European instruments, the disparity is still very great; and would have been more, had the Indian been obliged to have

worked with the instrument of the European, as he would scarcely have been able to have wielded it.[13]

Even personal qualities have been mustered as argument:

> Judging merely by knowledge of navigation and shipping, there was nothing to have prevented Asiatic seamen from rounding the Cape of Good Hope and discovering Europe . . . It was through courage that Europeans, especially the Englishmen, found their way to the East.[14]

While these factors should not be dismissed out of hand, their role (whatever it was) in shaping the course of Indian history remains largely unsubstantiated, and thus liable to lend itself to naïve conclusions. What is needed, therefore, is sustained study to test their validity, but such studies are hard to come by for the sixteenth and seventeenth centuries.[15]

That technology is not value-free, and wider cultural values determine the direction of technology has been assiduously shown by Arnold Pacey.[16] But this is only one segment of the problem. Utilitarian requirements and pragmatic considerations of a community or a class must be projected in a sharper focus than its values and moral objectives. Moreover, absorption or adoption of a foreign technology, or an art motif, or anything else, is inextricably linked to its compatibility with local receptivity, that is, tastes, customs, skills, profitability, etc.[17]

The present work is offered as a limited attempt at assessing the nature, degree and pattern of Indian contacts with, and response to, European technology and culture during the sixteenth and seventeenth centuries. The object is to determine, wherever possible, the reason behind the acceptance or rejection of specific innovations and features of European technology and culture. We have included in our study such techniques, or their products, as the Europeans brought to India, irrespective of whether they originated in Europe, or were imported and developed there. We have also taken casual notice of goods or techniques which do not fall under these categories only because they were brought to India by Europeans.

Further, as regards technology, we have to distinguish carefully between the pattern of response to the *use* of a foreign article, and that of its actual *manufacture*. It will be realized that this distinction is vital for the type of inquiry undertaken by

us. Again, the use of terms like values, attitudes, aspirations, objectives, receptivity, etc. is apt to be misleading unless we relate them to particular social groups or classes with possibly divergent interests. We cannot, at any time, have absolute values, or single, universal attitudes: they are only relative.

A word about presentation. First, we have usually tried to trace the stage of development achieved by Indian technology in the specific fields studied by us, prior to contacts with the Europeans. Secondly, we have allowed the original sources to speak for themselves frequently, and this explains the plethora of citations. The objective of this work is not a comprehensive inquiry, but the initiation of a line of research which has not so far received adequate attention. There is a need to undertake studies on this theme regionwise in order to enlarge our preliminary exploration.

And finally, an apology. The present work suffers from two obvious infirmities: first, it is based largely on Persian and English sources. The information contained in, for example, Dutch, Portuguese, or French sources has not been tapped except when available in English translation. Secondly, field-work, that is, scrutiny of existing material objects, especially those displayed or stored in museums, could not be as widely undertaken as we would have wished.

CHAPTER I

PROLOGUE

Any attempt at estimating the response of one culture to another perhaps inevitably entails a study of the degree and pattern of contact between members of the concerned culture-groups. Again, the pattern of contact will be influenced by a large number of factors, for example, the size of the country, both in terms of space and population, the number of foreigners and the location of their settlements in the country, the nature of their objective or mission, and also the means of diffusion of products and ideas brought by them. Viewed from these perspectives, when we come to the study of Indian response to Europe during the sixteenth and seventeenth centuries, we are repeatedly reminded of the sprawling geography of the Indian sub-continent, her enormous population as well as the different social groups and strata of her society at varying points of cultural development. It is therefore necessary to undertake a quick survey of the nature, degree and pattern of contacts between Europeans and Indians at several social levels and in different regions of the country.

REGIONWISE CONTACT

The story of the coming of Europeans to the Indian sub-continent should properly begin with Vasco da Gama's arrival at Calicut in 1498. Since that story has been told many times over by others it is not necessary to recount it here.[1] The essential point to bear in mind is the historical accident of the landing of the first batch of Europeans on the south-west coast of India and their co-existence over an extended period of time with indigenous culture-groups. This largely explains the existence of the Christian communities in South India, especially along the coastal regions, in far greater numbers than in inland areas during the two centuries under review. Coincidentally,

direct domination by Europeans was first manifested along the coastal regions—in places such as Goa, Bassein, Diu, Daman, etc.—and they remind us of the first flush of European military triumph. Other possessions like Pulicat, Madras, Bombay, Hugli, etc. were the results of yet another wave of European supremacy and strategy. It is precisely in these coastal areas under *European control* that we should expect a continuous and permanent thread of contact between Indians and Europeans. Moreover, places like Cochin and Sūrat which may be said to have come wholly or partly under the European 'sphere of influence' through the agency of fortifications or factories were also in close and continuous contact with Europeans.

Coming inland, big administrative and trading centres like Lahore, Delhi, Āgra, Patna, Dacca and Vijayanagar could boast of maintaining, by and large, permanent or at any rate semi-permanent links with Europeans. Indeed, this form of contact was available at all places where Europeans had established their factories. Quite obviously, such places were very small in number and could be regarded as no more than tiny islands in the context of the country's geographical magnitude.

It would appear that the countryside was at a comparative disadvantage. Only those places lying along the well-established trade-routes could be expected to have come into contact with Europeans. It is fair to infer that such contact was short-lived and casual as it was dependent only on *occasional* passage of Europeans through these territories. However, we must emphasize here the role of inns or *sarā'is* along these routes which, as halting places, provided convenient opportunities for bringing together an assortment of individuals, both native and foreign, in very intimate circumstances.[2]

Besides, we may also include those areas where a large number of Europeans, especially the Portuguese, flocked in their individual capacity, thereby forming points of contact and diffusion. For example, we are told: 'A large number of Portuguese dwell in freedom at the ports on this coast of Bengal . . . for certain misdeeds they have committed.'[3] For Vijayanagar, it was recorded: 'There are many Franks also in the kingdom, but most of them are Portuguese who have fled thither for crimes they have committed . . .'[4] Again, for Bengal: 'I judge, and am well satisfied in it, that there are noe less then 20,000

Frangues, and about half of them inhabit near Hughly river.'[5]

For other places in Bengal and Orissa, namely, Dacca, Chandipūr, Bālāsore, etc., and for Vijayanagar again, the report of the Augustine monks of Goa in 1697 is significant in that it shows Portuguese settlements, though small in size, in the interior.[6]

PATTERN OF CONTACT

The material at hand clearly indicates the existence of contacts with Europeans at several levels of Indian society—from that of sovereigns to artisans. Let us begin our examination of the evidence at the highest level, i.e. the 'court circle', which included rulers, nobles, and other high officials; in short, politically significant groups.

Regular and continuous direct contact with the Mughal court began with the arrival of the three Jesuit missions during Akbar's reign.[7] Such group contacts, in addition to individual ones, continued vigorously in Jahāngīr's reign.[8] Later, the nature and degree of such links appears to have diminished during the period of the next two Mughal sovereigns, that is, Shāh Jahān and Aurangzeb. When we say this, we have in mind the practice of inviting the Jesuit Fathers to the court to involve them in religious polemics with representatives of the Muslim orthodoxy during the reign of Akbar and Jahāngīr. This practice ceased under Shāh Jahān and Aurangzeb.

However, it would be totally erroneous to assume that European contact with the Mughal sovereigns revolved chiefly around the religious axis. Apart from the European objective of obtaining trade concessions, Indians were interested in acquiring specimens of European painting[9] and other novelties.[10] We are told in 1614:

> . . . all sea-port governours had expresse commandment from the Mogoll [Emperor Jahāngīr] not to suffer any trade with us till they had made choise of all strange things that we bring, and they to buy them for the Kings use and to send it unto him.[11]

Besides the sovereigns, presents were also given to distinguished female members of the Mughal harem, who thus learnt of the Europeans indirectly.[12] In addition, the Mughal

rulers and princes at times intervened whenever the commercial interests of Indian merchants or their own trading ventures were threatened or actually adversely affected. Thus, there were numerous channels, some friendly and some antagonistic, through which Mughal rulers and princes came into contact with Europeans on a variety of occasions.

Among several of the high noblemen who maintained links with Europeans the names of Shā'ista Khān, Ja'far Khān, Amānat Khān, Āsaf Khān, Muqarrab Khān and Mīr Jumla come first to mind.[13] By far the most colourful of these was Muqarrab Khān who was chiefly instrumental in procuring novel articles for Jahāngīr and also for himself, be it some item of European finery, a copy of a European painting, or a product of European technology. He even turned Christian for a while when he was sent by the Emperor to Goa for a variety of purposes.[14] Akbar too sent a certain Hājī Habībullāh to Goa to fetch European objects to the court,[15] while Jahāngīr sent yet another official there for the same purpose.[16] Many governors of the provinces had a number of opportunities for acquainting themselves with the novel products brought by Europeans. Once the governor of Gujarāt was presented with two European sword-blades, one 'combe-cace with instruments' and three 'pairs' of knives.[17] In another instance, we find that gifts suggested for governors and princes included globes, glasses, and 'substantial house-clocks'.[18]

Among the lower-ranking officials, the authorities at the big port-towns were better placed than any other group of officials as regards frequency of contact with Europeans. These contacts were essentially administrative, especially in connection with trade regulation. In addition, the royal fondness for exotic articles discussed above involved them too. However, there are instances to show that the governors (*mutasaddī*) of ports acquired foreign articles also to satisfy their own curiosity. For example, Zulfiqār Khān (1615) is reported to have bought 'plate dishes' from an Englishman; on another occasion, he asked for a few pairs of European tailors' shears which were duly given to him.[19] A *Shāhbandar* (custom official) has been mentioned in connection with the purchase of European anchors from Englishmen.[20]

The foregoing account may perhaps mislead us into inferring

that the rulers, princes, nobles and administrators cultivated links with the Europeans largely with the motive of obtaining European manufactures. Without belittling the role of these articles, we may point out that Indians were also interested in other aspects of European culture. Abul Fazl was aware of the discovery of America by the Europeans.[21] We are told that the governor of Junnār (1670s) interrogated Fryer on 'the state of Europe, the government, policy, and learning'.[22] His brother was a great admirer of European dress and very inquisitive about military discipline in Europe.[23] Fryer adds that he was not lazy 'as the Moors most are; but applying himself to several handicrafts, which he has learned of the Europeans'.[24] The frequent meetings of the governor of Ahmadābād with the German traveller, Mandelslo (1638), were perhaps of the same nature.[25] An officer of Mīr Jumla in Golconda once detained Tavernier, a Frenchman, for a long time in order 'to acquaint himself with our forms of government, and greatness of our King'.[26] When Manrique met Āsaf Khān (Jahāngīr's brother-in-law) at Lahore in 1640, the latter put to him various questions 'showing great inquisitiveness about foreign matters'.[27]

We have referred *en passant* to the religious debates conducted in the Mughal court between Muslim scholars and Jesuit priests. Prince Dārā often met Father Busi for academic discussions.[28] The same Father Busi is said to have talked on Mathematics to a 'Prince of the Blood who was Superintendent of the Nobility'.[29] And if we care to believe a contemporary traveller, Jahāngīr and Shāh Jahān had learnt principles of mathematics and astrology from the Jesuits.[30] 'Abdul Qutb Shāh, the King of Golconda, is said to have been greatly attracted by 'all those who are proficient in Mathematics . . . although a Muhammedan, he favours all Christians who are learned in this science.'[31] A Mughal noble, Dānishmand Khān, had established for six years intimate and regular intellectual *rapport* with Bernier bearing on philosophical and scientific matters which included astronomy, geography and anatomy. Bernier translated the works of European philosophers—Gessendi and Descartes—into Persian for this patron, and discussed with him the discoveries of Harvey and Pecquet on anatomy and physiology.[32] The discussion between Amānat Khān, the governor of Sūrat (1690s), and Manucci, the Italian

traveller, on alchemy being practised by the former is another instance of this type.[33] At a slightly lower level, we find a schoolmaster at Āgra in 1606 giving lessons for six months in the 'Persian tongue' to an Englishman.[34] Somewhere on the Coromandel coast, Bowrey records a dialogue he held with some Brahmans on the causes of eclipse; he writes of their 'strange fancies and notions'.[35] That there must have been no lack of opportunities for intellectual contact and academic discussion is betrayed by the remarks of some European travellers. For example, Careri observes about Muslim scholars: ' . . . As for Sciences they can make no progress in them for want of Books; for they have none but some small manuscript works of Aristotle and Avicenne in Arabick . . .'[36]

Again, we quote below at length another contemporary European opinion which must have been formed as a result of intimate intellectual association and observation:

> In esteem among them are principally Magick and Judicial Astrology . . . Grammar and Rhetorick, some of them being Masters of Persian, Indostan, Arabick, Sanscript . . . Portuguese, . . . nor are they quite ignorant of Medicks, though Anatomy is not approved, wherein they lean too much on Tradition . . . Arithmetick being the most profitable Science, is the best understood by them; to which they have a Natural propensity, and will in a trice without the help of pen or Ink cast up the difficultest sums, and never pause upon it.[37]

Apart from the royalty, nobility, administrators, scholars, etc., yet another section of Indian society that remained in continuous contact with the Europeans was the mercantile group. Since most Europeans came to India primarily to trade, either on behalf of their sovereign, joint-stock companies or on their own private initiative, it is quite easy to understand their extensive involvement with a multitude of Indians connected with commercial activities. It is not surprising then to find this aspect widely documented in European records of our period.

The moment the Europeans disembarked and unloaded their cargoes at any port, they were inevitably brought face to face with all sorts of persons connected with the trading world. First, they had to pass through the custom-house, where they met custom-officials and their subordinates.[38] After clearance from customs, or even before that, brokers offered their services.

The need for establishing contacts with numerous inland centres of production and the problem of language gave rise to a well-organized institution of brokers, especially during the seventeenth century.[39] It was rightly remarked that 'without these, neither you nor the natives themselves shall do any Business'.[40] Besides them, there were *sarrāfs* or money-changers to tender advice on the exchange ratio of the coins of different countries circulating in India; in addition, they issued bills of exchange and letters of credit, and also carried on insurance business, both inland and marine.[41] In fact, brokers and *sarrāfs* were the most important groups of the mercantile world with whom the Europeans had to cultivate trading contacts as a matter of routine. Of equal importance were the merchants of varying ranks with whom the Europeans entered into regular association directly, or indirectly through the brokers, for selling and buying goods; or occasionally for obtaining loans. The system of issuing passes or *cartazes* permitting Indian merchants to ply their vessels on the high seas (the lack of which made their ships and cargoes liable to confiscation by Europeans) was yet another reason that compelled Indians to establish contacts with the European companies.[42] There is also occasional evidence of Indo-European joint trading ventures on a small scale and of a temporary nature.[43]

Further, when Europeans had to transport their goods to distant places inland, or to bring Indian goods to the ports for lading their ships, they engaged several categories of persons: for example, professional armed guards to accompany the caravan, transporters (cart-owners and camel-drivers, etc.), and *adaviyas* or custom-contractors.[44]

It does not appear that artisans, especially those engaged in textile production, came into direct contact with Europeans on a regular basis: European business intercourse with them was largely through brokers or middlemen who arranged it through the 'putting-out' system or *ad hoc* purchase of goods from artisans.[45] Direct contacts were established in cases where the artisans appeared personally with their articles to sell them on the market,[46] or when instances of brokers' frauds were brought to light.[47] Direct contact could also occur when artisans were employed in *kārkhānas* (small-scale manufactories) sporadically erected by European companies, the earliest example of which

comes from Patna where the English company had employed a number of artisans for producing silk fabrics.[48] About Bengal, we are told, 'The Dutch have sometimes seven or eight hundred natives employed in their silk-factory at Kassembazar, where in like manner, the English and other merchants employ a proportionate number.'[49] At Palakollu on the Coromandel coast, the Dutch built in 1652 a 'Factory of a large compound, where they dye much Blew Cloth, having about 300 jars set in the ground for that work . . .'[50] There is no record of the number of Indian workers employed; but that it must have been quite large is clear from the extensive amount of the work described. We may also refer here to the erection of 'dyeing workhouses' by English factors at Sūrat where, once again, the number of Indian artisans went unrecorded.[51]

Furthermore, during the second half of the seventeenth century, the English company sent a few English dyers, weavers, throwsters, etc. to Qāsimbāzār in Bengal who are reported to have trained native craftsmen in the European technique of dyeing some special colours (black, blue, etc.) which the latter were unfamiliar with.[52]

Turning to shipbuilding, we find close contact between European and Indian shipwrights, the benefits largely accruing to the Indians, who imbibed a substantial knowledge of European technology in this sector.[53]

Direct contacts could also be shown in the saltpetre industry.[54] But there is very little evidence of any meaningful relationship between Europeans and the peasantry: at the most, an occasion for getting together might have occurred in the course of the purchase of indigo, sugar, tobacco, etc., though it is doubtful whether transactions in all these articles were carried out directly with the producers. Most probably, brokers and merchants were the dominant link in these transactions.

Another channel of close contact was the practice of Indians employing Europeans in several capacities. The former sought the services of Europeans as artillerymen, gunfounders, shipbuilding and navigational experts, jewellers and physicians. We need not spell out here details of any of the categories save the last one since the others are cited at appropriate places in this work. The examples of Bernier and Manucci serving as physicians under Indian nobles and sovereigns are too well known

to be described. The governor of Allāhābād is recorded not only to have employed Persian physicians, but also to have had in his service a certain M. Claude Maille of Bourges.[55] The ruler of Golconda employed a Dutch surgeon, Pitre de Lau.[56] Even 'half-caste Portuguese', that is, the mesticos, were considered fit for the job: we are told that Shā'ista Khān, the governor of Bengal (1660s), had one such in his service who induced miscarriages in eight women of his harem in a single month at the instance of the noble's wife who did not permit any children but her own to survive.[57]

This process occurred in reverse form too. Europeans started employing Indians. The credit for initiating such a practice among the Europeans should go to the Portuguese. The most prominent avenues of employment were seamanship and artillery. Indians, known as lascars, served aboard European-owned ships as common sailors.[58] They were largely drawn from the coastal regions, especially from Mālābār and Gujarāt. Sometimes these Indian seamen were carried to European countries and brought back.[59] Many Indians, either converts or slaves, were employed and trained by the Portuguese in gunnery, but it appears that the bulk consisted of the mesticos.[60] It is interesting that the English factory at Sūrat was served by an Indian physician in association with an English surgeon.[61] We have already referred above to the employment of Indian artisans in the *kārkhānas* maintained by Europeans.

A large number of nondescript Indians came into contact with Europeans by accepting sundry odd jobs under them: while some worked as cooks[62] and laundresses,[63] others served as attendants and peons at European company houses.[64] Many young boys took up jobs as private servants.[65] At Tranquebar, old Indian women were hired for fetching water from a distant place, and one woman was allotted to each room where the Danes lived.[66] Europeans, especially the Portuguese, kept slaves acquired through purchase but, more often than not, by forcibly capturing local people. While the bulk of them were brought from the eastern coast of Africa,[67] a reasonable number consisted of Indians. We are told that the Portuguese possessed six hundred slaves at Huglī acquired through violent means, which provoked Shāh Jahān to take action against them.[68] On the other hand, as a result of Shāh Jahān's assault on Huglī,

many Portuguese women were captured and distributed among the members of the harem, nobles, etc.[69]

Direct contact of Indian womenfolk at the higher social level with European males was utterly inconceivable. European physicians might be called upon to attend on an ailing lady,[70] but such contact was not of much consequence. However, Indian women at the lower end of the social hierarchy accepted social intercourse with European males as their mistresses and wives.[71] At Madras, where the English settlement in Fort St George was divided into White town and Black town, young white gallants climbed over the walls in the night and made for the Black town to meet their coloured paramours.[72]

The foregoing account, touching on the pattern and nature of contact between Europeans and Indians, may not be exhaustive, but it helps us to form an idea of the broad spectrum of such contacts, and also indicates the channels of diffusion of the numerous aspects of European culture and technology.

NATURE OF RESPONSE (GENERAL)

While details of the Indian response to European technology and culture are to be found at relevant places in the present work, it is necessary to begin by tracing the broad pattern of such responses.

One of the results of the rounding of the Cape of Good Hope by the Portuguese was the introduction of the element of force in the foreign commerce of India. When the Portuguese reached the Western coast, they found merchants, both Hindu and Muslim, plying their vocation cordially and peacefully, i.e. if we ignore the occasional acts of piracy. The Portuguese realized that since their financial resources were meagre they would fare very badly in peaceful competition with Indian and other Asian merchants. They could make a breakthrough only with brute force by taking advantage of their naval superiority. This they proceeded to do with a ruthlessness unprecedented in the history of Asian commerce. As a consequence, the first reaction of the Indians was of resentment, awe, fear, and even contempt, born out of their humiliation.

A contemporary Muslim writer of Mālābār observed in 1583

about the Muslims:

> The Muslims of Malibar lived a happy and prosperous life on account of the benevolence of their rulers . . . But the Muslims undervalued the blessings of Allah, and transgressed and disobeyed. So Allah set on them the people of Portukal, who were Christians. They oppressed the Muslims, corrupted them and committed all kinds of ugly and infamous deeds, too bad to be described. . . . They prevented the Muslims from their journeys, especially their pilgrimage to Makka. They plundered their properties, burnt their cities and mosques, seized their ships and torn down the Quran. . . . They beat the Muslims with shoes . . . tortured the Muslims with fire, and kept some as slaves and employed some of them for all kinds of hard labour without any compassion.[73]

Later in the 1590s, Pyrard wrote about the Portuguese in Mālābār that 'I never heard of a good word said for them.'[74]

The policy of terrorization infected other European nations too in varying degrees. Not surprisingly, when some Englishmen approached Olpad in 1615—a port-town in Gujarāt—we are told that 'the people were very fearfull of us and were readye to run all way out of the towne at first sight of us'.[75] Since the Mālābārīs, who were 'strict Muhammadans', had suffered enormously at the hands of Europeans, we find them emerging as their inveterate foes. Undoubtedly, Peter Mundy is right when he says in 1656 that 'the Mallabars are our mortal enemies in these parts . . .'[76] The consequences of a European falling into the hands of the Mālābārīs were dreadful, only matched by severe counter measures, especially with the Portuguese.[77] Till the end of the seventeenth century there is no relaxation in the bitter animosity and acts of ruthlessness from either side. Similarly, the Portuguese brutalities at Huglī in the 1630s alienated the 'Moorish Maulanas' of Dacca who once expressed their resentment by entering a Catholic monastery and beating up two priests.[78] On the other hand, a 'friendly Moor Merchant' at Āgra is reported to have given 3,000 rupees to the 'Padre grande' there.[79] Outside India, a Khatrī merchant in Qandahār told Manrique in 1641: 'I am deeply attached to your nation, as it was one of the principles followed by my family, who always kept on friendly terms with them in the cities of Cambay and Amdavar [Ahmadābād].'[80]

Perhaps in regions where Europeans had the capacity to exercise violence, the local population's attitude was a blend of hostility and awe.

There were certain areas of European skill and ability which invariably drew admiration from Indians: for example, artillery and seamanship. Thus Manrique writes: '. . . for being a Portuguese, they would imagine that I must know all about the various engines used in war, especially about fire arms, as in the opinion of the people of those parts we were all most expert in such arts.'[81]

The general impression in the minds of Indians about European military skill is best illustrated by a 'proverbe' current in India during the early decades of the seventeenth century that 'one Portuguese will beate three of them [Indians], and one Englishman three Portugals'.[82] Indeed, the first part of the proverb is corroborated by Tavernier's arrogant and haughty remark that 'one hundred of our Europeans would scarcely have any difficulty in vanquishing 1000 of these Indian soldiers . . .'[83] As for seamanship, it was believed that Europeans were the 'Lions of the sea'.[84]

The attitude of Indians to European skill in medical science is interesting. While Indian physicians did not believe or admit that European doctors were properly acquainted with medicine,[85] the masses held a different opinion. We are told in 1634:

> For these Barbarians hold that wherever a Portuguese goes good fortune and skill attend him. Indeed so general is this opinion in those regions, that as soon as any Frangui arrives at a place and it becomes known, they at once bring up their sick, all kinds of diseased persons coming to consult them and beg for remedies and drugs for their ailments, just as if the skill of Esculapius, Galen, and other great men who professed the art of medicine was a natural attribute of the nation of those whom they style Franguis.[86]

An assessment of the general accomplishment of Europeans is exemplified by Muslims of a village in Orissa who exclaimed that 'Allah, the sacred, has bestowed much wisdom on the Franguis . . .'[87] On the other hand, Indians had certain reservations too. For example, once Shāh Jahān is recorded to have observed:

> In truth, the Franks would be a great people but for their having three most evil characteristics: first they are caffars; secondly, they eat pork;

and thirdly, they do not wash that part from which replete Nature expels the superfluities of their corporeal bellies.[88]

In fact, there was a general belief among Muslims in India that every European dish contained some pork.[89] Similarly, Hindus showed reservation because they ate chicken and beef.[90]

DEGREE OF INDIAN RECEPTIVITY AND EUROPEAN COMMUNICATIVENESS

In the course of the first decade of the seventeenth century, Pyrard remarked that 'They are unwilling indeed to adopt manners and customs of the Portuguese; yet do they readily learn their manufactures and workmanship, being all very curious and desirous of learning.'[91]

One thing that particularly struck Europeans was the outstanding ability of *imitation* that Indian artisans so impressively possessed. This 'genius for imitation' was known to the former even in ancient times. For example, Nearchus pointed out that when Indians saw sponges in use among the Macedonians, they tried to imitate them by sewing hairs, thin threads, and strings, 'inextricably through flock of wools, and, after the wool was felted together, drawing out the hair and thread and strings, when a perfect sponge remained which they dyed with bright colours'. They also imitated Greek scrubbing brushes and vessels for oil.[92] Long afterwards, Terry, the English traveller, records (1614):

> The truth is, that the natives of that monarchy [the Mughals] are the best apes for imitation in the world, so full of ingenuity, that they will make any new thing by pattern, how hard soever it seem to be done; and therefore it is no marvel if the natives there make shoes, boots, cloaths, linen, bands, and cuffs, of our English fashion, which are all of them very much different from their fashions and habits, and yet make them all exceedingly neat.[93]

Immediately following him, Pelsaert, the Dutch traveller, observed about Āgra (1620) that the city contains 'all sorts of artisans in great numbers, who can imitate neatly whatever they see, *but design nothing by themselves* [emphasis ours]'.[94] And finally, Ovington, the English chaplain, remarked (1689):

> The Indians are in many things of matchless Ingenuity in their several Imployment, and admirable Mimicks of whatever they affect to copy

after . . . The weavers of silk will exactly imitate the nicest and most beautiful patterns that are brought from Europe. And the very ship-carpenters at Suratt will take the Model of any English vessel, in all the curiosity of its Buildings, and the most artificial Instances of workmanship about it, whether they are proper for the convenience of Burthen, or of quick sailing, as exactly as if they had been the first contrivers . . . The Tailors here fashion the cloaths for the Europeans, either Men or Women, according to every Mode that prevails; and fit up the commodes, and towring Head-dresses for the women with as much skill, as if they had been an Indian fashion, or themselves had been Apprenticed at the Royal Exchange . . .[95]

We may add here that the Indian artisan did not make any item after a foreign model or pattern unless he was commissioned to do so by his patrons and clients.

It would be useful to examine how far Europeans communicated their skills to Indians. We have already hinted that the Portuguese did not have any reservation. To a lesser degree, the English too were not averse to imparting European skill to Indians. However, the Dutch do appear to have been a little reticent. We are told that they employed 'men of theire Nation' in their factory at Palakollu on the Coromandel coast as rope-makers and blacksmiths for supplying most of their fleets with materials produced by them.[96] Fryer, the English traveller, reveals (1670s): 'The Dutch never permit the Natives to be taught any Eminent Art whereby they may become their competitors . . .'[97]

In fact, Fryer wished his countrymen to take the cue from the Dutch against 'technology transfer'. He adds:

> Nor is it, I think, better policy to instruct them in any beneficial science, as that of Navigation, no more than one would an adversary how to use his weapons; which these, had they equal courage to their other Advantages of strength and Nature, might easily thereby turn the points of their Weapons upon us.[98]

But, as we will show, the English paid no heed to this 'patriotic' advice.

In fact, the Dutch 'secretiveness' was not confined to the Indian sub-continent: the pattern was the same in other countries of Asia, wherever they settled. They never showed any enthusiasm, for example, in Japan, to 'lay bare the art of casting guns after the European fashion to the eyes of the skilful

Asiatics'.[99] At Batavia, cannon-founding was shifted to a less conspicuous place because the previous site was considered to be 'too close' to the view of the 'natives and Javanese from whom this art should certainly be kept secret'.[100]

Having set the stage with somewhat inadequate trappings, let us raise the curtain to look at some specific scenes of the drama of the West and the East being brought together on the Indian sub-continent through one historical accident—the rounding of the Cape of Good Hope.

CHAPTER II

TECHNOLOGY

Since India's direct, and momentous, contact with Europe followed the discovery of the sea-route via the Cape of Good Hope, it would be appropriate to investigate first the impact of European seaborne transport technology, i.e. shipbuilding, on India's.

SHIPBUILDING

To date we have no access to log books and other records of Indian ships, if they survive, comparable to those available for European ships, setting out method of construction, cost of production, number and names of officers and crew, dates of sailings and particulars of voyages, details of goods and victuals aboard, etc.[1] Notwithstanding the limitations of our sources, it is possible to explore a few details of the process of adoption or rejection of European technology in this sector, largely from European records.

Caulking

One feature of the indigenous shipbuilding craft that repeatedly drew the attention of European observers was that while Indian shipwrights constructed their vessels by the 'rabetting' method, Europeans took recourse to caulking.[2] Since the entire vessel in medieval times was constructed of wood, various methods in carpentry were employed to join the timber or planks;[3] and rabetting was one of them.[4] A study of the close-ups of vessels depicted in Mughal paintings not only supports the European remarks, but, in addition, they also show other methods of joining the planks together of which there is no mention in European records.[5]

On the other hand, caulking is a technique of making joints or seams tight or leakproof by forcing oakum[6] between parts

that are not tightly fitted. Thus, caulking was actually the next step in European shipbuilding after the planks were joined together by any method in carpentry. It is not that rabbeting was not done in European vessels; indeed it fell completely into disuse in Europe only at the end of the first half of the nineteenth century.[7] What seems to have happened is that for certain reasons this technique was not generally favoured in Europe, while the Indian vessels were for the most part rabbeted.

Did Indian shipwrights adopt caulking under the influence of Europe? Varthema, who came to India only about six years after the Portuguese presence in the Indian Ocean, makes an emphatic statement about Indian ships on the Western coast: '. . . they do not put any oakum between one plank and another in any way whatever . . .' But, he also cautions: 'Do not imagine, however, that they have not any oakum, for it comes in great abundance from other countries, *but they are not accustomed to use it for ships* [emphasis ours].'[8]

This indicates that Indian shipwrights had learnt of the use of oakum in European ships but had not adopted it. Perhaps it could be said that the duration of contact was too brief for any substantial change. Let us, then, trace it after a reasonable passage of time.

In 1647, more than a century after the Europeans came to India, a ship of 'European' build bought for Prince Dārā Shukoh was later rejected 'for being . . . major part calked and not rabited, which building is only known to these people'.[9] This ship, originally in the possession of the Portuguese 'Captain' of Daman, was built in India[10] under supervision of European chief carpenters, and in association with Indian artisans. Such ventures were common,[11] apart from the practice of buying ships of Indian build by the European Companies.[12] Thus, Indian ship-carpenters had had the opportunity of being exposed to the European technique of caulking. The remark that rabbeting 'is only known to these people' (and not caulking) tends to indicate that the Indian ship-owners did not show positive interest in this device even after contact with Europeans of long duration. What explanation could we offer for such indifference?

Caulking, in its essence, was one of the ways to make the lines of junction between the edges of planks tight or leakproof.

Contemporary observers do not speak of any technical superiority of caulking over the Indian method of performing the same task. Indeed, the situation in this respect was different. As early as the first decade of the sixteenth century, Varthema noticed that '. . . they join the planks so well that they keep out the water most excellently'.[13] The next step was to smear the planks with indigenous pitch or tar, and lime, with the double purpose of stopping up any fissures and preserving the timber from seaworms. Fish-oil, probably mixed with other ingredients, was also used in daubing the planks.[14] The excellence of Indian technique drew admiration from the English factors also in the second half of the seventeenth century. They wrote from Bombay (1668):

> . . . the carpenters wrought their worke very cheape, substantiall, and strong, of planke let into each other, with cotton and tarr, and then spiked, which is called rivetting worke, this is, to our knowledge, very lasting, and admitts of noe caulking.[15]

That caulking did not possess any intrinsic technical superiority is quite clear: this might explain the indifference of Indian shipbuilders to it.

But this was not all. In 1619, it was estimated by one of the members of the English East India Company that by building a ship of 500 tons in India as against the shipyards of Deptford and Blackwell in England as much as £1,000 could be saved.[16] We have shown elsewhere that, on an average, the cost of production (per ton) of ships built in India was invariably much lower than that of those built in Europe, at times almost half.[17] The comparatively cheap production of an Indian vessel reflects the low outlay on men and materials. The cost of materials in England was sometimes eight times the cost of labour there.[18] The material for caulking, besides timber, etc. must also have been expensive. In 1673, Abbé Carré says that when a French ship started leaking, 'she had to be caulked at Sūrat, which had cost a considerable sum'.[19] Earlier, in 1668, when the English factors persuaded the Company to start building ships at Bombay, one of their pleas was that the Indian method of joining planks was such that 'this excuseth all caulking worke, ocum, pitch, and tarr, with the expence of a many carpenters and caulkers'.[20] Had caulking been a better tech-

nique, the English would not have pleaded that it be given up. Their main argument seems to have been that the Indian method of making a seam leakproof was as good as European caulking, maybe even better, and it had the advantage of lower cost. Thus, the reluctance of the Indian shipbuilders in not adopting the European method is wholly justified: it had no technical superiority to recommend it, nor was it advisable on economic grounds.

However, there is one disturbing point. In connection with the purchase of a ship on behalf of Dārā Shukoh, we said above that she was subsequently rejected on the grounds of her being for the larger part caulked. The ship was of 250 tons, and later the English bought her for 13,500 rupees. This works out at 54 rupees a ton,[21] while the Indian rate of construction ranged from 30 to 40 rupees a ton. Was she, then, rejected by Dārā's officials on the grounds of high cost? An answer in the affirmative would be tantamount to underrating the wealth of a Mughal prince. One might perhaps see a trace of conservatism in this particular case, but it might also be a result of distrust in the European device of caulking which was, at any rate, partially justifiable.

Sewn and Nailed Ships

Another, but more important, difference noticed by Europeans was that while the Indians joined the planks by stitching or sewing them with ropes, the former did so by using iron nails. In A.D. 1292, John of Monte Corvino observed that 'their ships in these parts [i.e. South-West] are mighty frail and uncouth, with no iron in them, and no caulking. They are sewn like clothes with twine. And so if the twine breaks anywhere there is a breach indeed! . . .'[22] Remarks like this are repeatedly met with in later centuries concerning ships built in the Indian Ocean zone.[23] It may be mentioned here that the Chinese used iron nails in their ships long before the appearance of the Portuguese in Asian waters.[24]

If the frail frame of Indian ships was due to lack of iron, why did Indians (and Arabs) fail to recognize it prior to the advent of the Portuguese? Attempts have been made to explain this nonchalance;[25] we need examine only a few of the most relevant points.

Marco Polo's opinion about the ships of the Persian Gulf ('ships of the worst kind')[26] was based on their being sewn with yarn or twine. He explains the absence of iron by laying the blame on the hardness of wood locally available which was prone to split or shatter if pierced with iron nails. This explanation has been rightly rejected as one of universal application;[27] indeed, Indian wood for shipbuilding, especially the teak, was highly praised by the foreigners. Ovington, in 1689, commented:

> The wood with which they build their ships would be very proper for our Men of War in Europe; for it has this Excellence, that it never splinters by the Force of a Bullet, nor is injured by those violent Impressions, beyond the just Bore of the Shot.[28]

At any rate, Indian teak was capable of taking in iron nails as was amply demonstrated in subsequent centuries.

Again, al-Mas'ūdī's explanation (tenth century A.D.) that Indian Ocean water corroded iron, thereby making the nails grow soft and weak, is not tenable.[29] Europeans do not seem to have complained about it during the sixteenth and seventeenth centuries.

Moreland (and, following him, Hourani also) offers a plausible explanation for the absence of iron in Indian Ocean ships: they attribute it to the high cost of iron in territories bordering the Indian and Arabian Oceans. We hardly have any evidence of the price of iron in India during the sixteenth century. Moreland devised an ingenious method of tentatively computing the price by reading back the prices during the late sixteenth and early seventeenth centuries. But the validity of his method may be questioned from the point of view of the problem confronting us. Actually, our main effort should be to ascertain the relative cost of iron nails and cordage. Notwithstanding the inadequate availability of information on the prices of these two items, it is fair to infer that for a variety of reasons the mining, smelting and manufacturing of iron must have been very expensive when compared with the stitching material 'which was ready to hand, and required no elaborate manufacture'.[30] The stitching material was derived from coir, i.e. the fibre of the coconut husk, widely available in Mālābār, Ceylon and the Maldive islands.

Thus, it may be suggested that prior to the advent of the Portuguese, Indian shipbuilders were justified in adhering to their method of sewing the planks, as against that of nailing them, for two simple reasons: (a) the easy procurement of raw material, and its comparatively low cost; (b) it did not affect their trade and profit, at any rate, in this part of the world. The sewn ships may have hampered Indians (and the Arabs) in rounding the Cape of Good Hope,[31] but their main interest did not lie in that direction.

The lack of this interest was more than compensated for by Europeans when the Portuguese explored the new sea-route in 1498. This unprecedented navigational feat, coupled with inglorious savagery born out of their armed naval might, dazed Indians for a while.[32] The latter saw their vessels being destroyed by the Portuguese with astonishing ease; and for the first time they encountered brutal restraints on their trading activities. Barros wrote:

> It is true that there does exist a common right to all to navigate the seas, and in Europe we acknowledge the rights which others hold against us, but this right does not extend beyond Europe, and therefore the Portuguese as lords of the sea by the strength of their fleets are justified in compelling all Moors and gentiles to take out safe-conducts under pain of confiscation and death.[33]

The Indians soon realized the secret of European supremacy at sea: it lay in the strength of European ships nailed with iron, the effective use of artillery fired from their ships, as well as their navigational skill.

How did the Indian ship-owners and builders respond to this new situation? It is remarkable that the Indians lost no time in adopting the new technique. They sensed the danger and readily adopted the alien technique of iron nailing. It was no accident, then, that an Arab merchant in 1507 built a galleon in the Portuguese style in Gujarāt.[34] When Goa was conquered by Albuquerque in 1509, a good deal of pitch, oakum, cordage and nails were discovered in storehouses.[35] Even earlier (1501), Cabral was given to understand that the ships on the south-west coast were 'made with the iron nails'.[36] Varthema, writing about Calicut in the first decade of the sixteenth century, observed the use of 'an immense quantity of iron nails' in Indian ships.[37] Such examples of iron in Indian ships might lead us to

believe that this device must have been in use even before the advent of the Portuguese. But this would not be correct. In fact, we do not have any such evidence before the sixteenth century. That these examples actually occur only after the arrival of the Portuguese in Asia indeed supports our argument that the approval of nailing the Indian ships bears a direct relation to contacts with the European vessels.

This practice continued unabated. In the 39th regnal year of Akbar (1593), a ship was constructed on the bank of the Rāvī at the Emperor's orders. Abul Fazl provides some details about her which, incidentally, is perhaps the only documentation of this nature for an Indian ship so far available in the entire Persian and European literature. We are told that 2,936 pieces of big planks (*shahtīr buzurg*) and 468 maunds (Akbarī) and two *sers* of iron went into her. He adds that 240 carpenters and blacksmiths worked on her, and it took ten days for 1,000 persons to launch her in the river.[38] What is of interest to us is the amount of iron used which is in consonance with Varthema's remark that 'an immense quantity of iron nails' was used in Indian ships. That the use of iron nails must have become a frequent feature in Indian shipbuilding is corroborated by some of the Mughal paintings which clearly show the nails, obviously iron ones, and also metallic strips or clamps especially used in rivetting the planks when the rabbeting method was not employed. It is of interest to note that most of these paintings relate to the late sixteenth century.[39]

That the seventeenth century saw a comparative enlargement of the output of iron is implicit in what Moreland says for the early years of the century.[40] In the second decade, we notice Narsapūr on the Coromandel coast emerging slowly as a shipbuilding centre where vessels of 'not less than 600 tunnes' were 'substantially built of very good timber and iron . . .'[41] Soon it rose as a well-established shipyard in the second half of the seventeenth century.

This does not mean that sewn ships were displaced totally by the nailed ones.[42] What seems to have happened was that while sewn ships were retained generally for the coastal trade, long-distance voyages were undertaken largely in nailed ships. This, however, should not be taken to mean that coastal trade was

not under the European threat;[43] but the threat was not of the same magnitude as that to long-distance voyages, viz. to the Persian Gulf or Red Sea regions.

Iron Anchors

Once the use of iron was accepted in principle, its extension was sought to anchors also. Compared to nails, iron anchors were slow to catch on. When Varthema speaks of the 'immense quantity' of iron nails, he also states that Indians '. . . carry anchors of marble . . . has two large ropes attached to it . . .'[44] He adds that these anchors were 'eight *palmi* [spans] long and two *palmi* every other way'. We know that the Arab navigators possessed iron anchors called *hadīd* which were used on particular occasions only, while stone killicks were in regular use.[45] We cannot affirm that Indians learnt the use of iron anchors from the Arabs.[46] In fact, Varthema's observation on the use of stone killicks finds support in a Persian glossary, *Miftāh-ul fuzalā'*, compiled during the second half of the fifteenth century at Māndū (Malwa). It defines *langar* (anchor) as the 'stone of a *kishtī* [boat] which is heavy'.[47] It is only from the seventeenth century that an active response to iron anchors is discernible, in all probability under European influence. *Farhang-i Jahāngīrī*, a lexicon prepared during Jahāngīr's reign, refers to *langar* as made of 'iron [fixed] in the ground in order to secure the vessel from moving away'.[48] Another lexicon, *Bahār-i 'Ajam*, compiled in the eighteenth century, describes *langar* as a 'heavy [piece] of iron attached to the vessel to prevent it from moving away'.[49] *Mir'āt-ul haqā'iq*, a diary written during the 1720s, also speaks of *langar-i āhnī*, that is, anchors of iron.[50] Thus, somewhere between 1550 and 1600 Indians began to use iron anchors. This development quite fits in with the scheme of things: in point of importance, iron nails should have got priority; anchors could wait a while till the production of iron was large enough to meet the demands of shipwrights.

Perhaps the first phase consisted in buying iron anchors from Europeans. In one of the recorded examples (1615) we find the *Shāhbandar* of Sūrat purchasing an English anchor.[51] Later, attempts were made at its manufacture. The real breakthrough appears to have been made in the second half of the seventeenth

century when Bowrey, referring to shipbuilding centres at Narsapūr and Madapallum on the Coromandel coast, observed:

> . . . the best Iron upon the coast is for the most part vended here and att reasonable rates, with the workmanship alsoe; and sort of Iron-worke is here ingenuously performed by the Natives, as Speeks, bolts, Anchors, &c.[52]

Referring to Orissa, Hamilton wrote at the end of the century that 'Iron is so plentiful that they cast Anchors for ships in moulds . . .'[53] But it must be conceded that iron anchors made by Indians were of inferior quality. Hamilton remarks that 'they are not so good as those made in Europe'.[54] In 1661, the English factors realized that 'propper' nails and anchors were not procurable at Sūrat.[55] It is no wonder, then, that Aurangzeb (1660s) proposed to buy ten or fifteen great anchors, each weighing 110 maunds at rupees eight per maund, which the English factors requested the Company to send them from England.[56] Again, in the 1670s, we see that English anchors found customers at Sūrat.[57] The deficiency in quality apart, the main point is the active interest shown by Indian ship-owners in iron anchors.

However, it does not imply that stone killicks were set aside. A close look at the painting of a ship in the travelogue, *Anīs-ul hujjāj* (1669–70), discloses an anchor (?) which apparently is of stone.[58] Again, a Portuguese *cartaz* of 1704 reveals that a ship owned by a certain Kalyān Muljī carried two anchors of iron and two of stone.[59] So far we have not been able to trace a sketch of an iron anchor in the Mughal or other schools of painting in India relating to the seventeenth century. Nonetheless, Bowrey's drawing of two Indian Boats—'Purgoo'[60] and 'Patella'[61]—show two-armed iron anchors of the European type.[62]

Cables and Cordages

There are numerous references to rigging materials, that is, cordage and cables, in contemporary records. It is well known that they were made of coir unlike the European hempen ropes.[63] Linschoten, writing in the 1580s, speaks favourably of Indian cables, but points out that they must be stored in salt water to keep them strong. It was discovered, while on a voyage,

that the cables 'served us as well as cables of hemp' when they were washed in the sea every fourteenth day. He further adds that they rot quickly in fresh or rain water since they are not daubed with pitch or tar like their European counterparts.[64] About a century later, Bowrey emphatically says that Indian cables are 'as strong as any hempen cables whatever and much more durable in these hott climates . . .'[65] (one note of caution is that he is referring to cordage imported from the Maldive islands).

Despite these favourable comments, we find the English factors complaining in 1639 that rope obtainable at Sūrat is 'neither so usefull, durable, nor becoming English vessells'.[66] In 1647, and again in 1652, the English factors at Sūrat asked the Company for cordage, etc. from England and requested the services of a ropemaker since the previous one had left India for home.[67] It is fair to infer that Indian cables were considered inferior in quality, and also cumbersome in the sense that they had to be frequently washed in saline water. The reasons appear to be twofold: first, the ropes were not dressed with pitch; and secondly, we suspect, the skill at twisting was perhaps not of the same standard as in Europe. In 1652, when the English factors at Sūrat asked for a ropemaker to be sent from England, they argued that he could make small cordage from 'country hemp' at half the cost in England. While this, incidentally, shows the comparative inexpensiveness of Indian ropes, it may probably also suggest that there was some special, and perhaps better, method of making ropes not known to Indians. Since labour was cheap in India, Indian ropemakers could have done the job after their own fashion at a lower cost than the factors expected from the English ropemaker. Our interpretation is that cost was merely a secondary argument: the factors required a European craftsman to make ropes in the European manner. We must remember that the Dutch at Palakollu on the Coromandel coast employed ropemakers of their own country all the year round.[68]

What, then, was the response of Indian ropemakers? In the 1670s, Bowrey refers to two types of pitch or tar used in the Achin region: one prepared by boiling 'oyle' with $\frac{1}{3}$ its quantity of '*dammar*', and the other by boiling $\frac{2}{3}$ *dammar* and $\frac{1}{3}$ 'oyle' together. The former, in his opinion, was not serviceable for any

ropes by reason of the 'oyle', while the latter was a 'very Excellent sort of pitch, not inferiour to the best wee use for our shippinge in England'.[69] These two preparations must have been known to ropemakers in the southern peninsula, or at least on the Coromandel coast. He says: 'And indeed wee have noe other pitch or tarre in any of the Easterne parts of the knowne world.' That *dammar*, a sort of resin from the sea, was quite well known on the Coromandel coast is borne out by Fryer.[70] What we wish to suggest is that the use of pitch or tar for ropes may have begun in some regions of peninsular India in the latter half of the seventeenth century. But there is no evidence of this practice on the coastal regions of northern India. Even in 1661 tar was not available at Sūrat.[71]

As regards the second aspect, that is, the European skill at twisting, there is one hint from Bombay in the 1680s when the English were already well-settled there. We are told that the native ropemakers had become so expert that 'They make them as in Europe. They are very serviceable and lasting . . .'[72]

To sum up, we do not see much interest in catching up with the European quality of ropemaking, except in the southern regions, and that too, perhaps, under the occasional supervision of foreigners, as in Bombay. Nor do we find any significant desire on the part of Indian ship-owners to purchase European cordage. Perhaps the former did not see much harm in continuing with the cheap,[73] though a little inconvenient, rope made in India.

Casks and Tanks

Turning to internal structure, we notice a feature that distinguished Indian ships from the European ones: since fresh water was very necessary on a long voyage, Indian seamen, according to European sources, provided themselves with water by storing it in one or two big 'four cornered wooden cesterne' or 'tanks', well pitched, and placed by the main mast ('amidshipps'), reaching from the lower deck to the bottom of the hold from which water was drawn 'as from a well'. Europeans, on the other hand, used casks, jars, or pipes.[74] Abul Fazl says that the ship's accountant (*karrānī*), a member of the ship's crew, was entrusted with the function of providing fresh water to the passengers, but he does not tell us how the water was stored on

the ships.[75] *Anīs-ul hujjāj*, however, refers to the rationing of water to passengers aboard from the *fintās*,[76] a term signifying a 'tank' in which the ship's water was stored.[77]

Two disadvantages were noticed in the Indian system:

(a) The tanks occupied a lot of space in the hold[78] (although Pyrard's observation was just the opposite, that is, they 'take up less room').[79]

(b) Pyrard pointed out:

> . . . our system of pipes is better for one reason, namely, that if any accident happens to these cisterne they lose all water at once. It is not so with us, for in case of a cannon-shot, all that can happen is the loss of one or two pipes; or if any one goes bad, all the water is not spoiled. Throughout the whole of India they nowhere use our system of pipes.[80]

Nonetheless, we find that response to this, for certain reasons, was wholly negative. The casks frequently needed repairs for which the constant service of a cooper was necessary. In fact, the English factors in 1668 recommended the Indian tank to eliminate the expense of a cooper.[81] Moreover, the Indian tank's capacity was larger than that of the European device.[82] Sometimes when Europeans built a caulked ship in India, they adopted the Indian method of storing water.[83]

What if the stock of water ran out while the ship was on the high seas, far away from ports of call? In 1686, an order was issued to provide the English Company with 'one Engine to make salt water fresh, with all other Materialls there unto belonging'[84] (this 'Engine' cost £50). It must have been a sort of boiler, but we cannot say whether it was actually used on English ships in Asian waters. Apart from the water supplied from the *fintās*, the author of *Anīs-ul hujjāj* recommends that the passengers must carry some fresh water in containers of their own which should be guarded by themselves. He further adds that in the event of fresh water running out in the middle of a voyage, it could be replaced by boiling sea-water.[85] We do not know whether Indian ships carried any special boiler like the one mentioned above.

Pumps

From storage of fresh water we proceed to examine the method of bailing out water that had leaked. According to Abul

Fazl, a category of seamen was that of *khalāsīs* whose chief was called *gumtī*. Their duty was to bail out the water which had leaked through the seams, or collected in the ship during a storm.[86] Neither the *Ā'īn*, nor any other Persian literary source, alludes to the device by which water was to be bailed out. At least one European account hints at the use of buckets by which the Indians cleared water manually.[87] The author of *Anīs-ul hujjāj* merely says that the passengers should help the crew in bailing water out when the ship was endangered.[88] However, two Mughal paintings from late sixteenth century show the use of buckets.[89] On the other hand, European ships were fitted with pumps.[90] They used piston-pumps before the opening of the seventeenth century, but shifted to (iron) chain-pumps[91] (though not entirely)[92]—perhaps inspired by the Chinese who are reported to have employed wooden chain-pumps.[93]

These pumps could not fail to arouse the curiosity of Indians: Muqarrab Khān, in-charge of the ports of Sūrat and Cambay in 1612, asked the English to provide him with a model of a 'chaine-pumpe', which may have been presented to him.[94] In 1652, Tavernier travelled in a large vessel belonging to the King of Golconda, from Masulipatam to Gombroon (Bandar 'Abbās), piloted by six Dutch seamen and assisted by one hundred Indian sailors. She had a few pumps aboard, perhaps old ones, which failed to work when the need arose to bail out water.[95] Does this evidence establish that Indians had started using pumps at some stage? It may be reasonable to presume that in circumstances when the Indian ship-owners engaged European navigators to direct their vessels (for which we have numerous references),[96] pumps were taken aboard in some instances. The initiative might have come either from the European pilots, or in imitation, from the Indian ship-owners themselves. In either event Indian seamen had obvious opportunities for adequate acquaintance with this novelty; after all, the task of operating the pump was that of Indian sailors since Europeans were invariably employed as captains or mates.[97] We suggest that there is a likelihood of pumps being used on Indian ships during the second half of the seventeenth century, though the practice might not have been widespread. Besides, these pumps must have been purchased or borrowed from Europeans since there is no evidence of indigenous manufacture.

The Capstan

Based on the principle of the wheel and axle on a vertical axis (in contrast to the windlass on a horizontal axis), the capstan was used in Europe long before the seventeenth century for hauling heavy objects,[98] though its use for weighing up anchors had just begun in the seventeenth, or perhaps the last decade of the sixteenth, century.[99]

It is difficult to establish its use among Indians before they came into contact with Europeans. When Sultān Feroze Shāh Tughlaq (1351–88) brought the two inscribed Ashokan pillars to Delhi, the pillars were hauled up and loaded on boats and carts with the help of a complex arrangement of a series of pulleys described and sketched in the *Sīrat-i Feroze Shāhī*.[100] Neither literary sources nor paintings indicate the use of the capstan by Indians prior to the seventeenth century.

In 1501, we are told that formerly Indians on the south-west coast were 'accustomed' to use two elephants, one on each side, for launching a ship. Since the elephants sometimes caused the death of seamen, this method was abandoned; instead, 'a great number of people come, who launch them'.[101] Later, Varthema observed at Cannanore: 'They put the side of the vessel foremost, and under the said ship they put three pieces of wood, and on the side next the sea I saw three elephants kneel down and with their heads push the ship on to dry land.'[102] By 1610, Pyrard saw elephants drawing 'ships and galleys ashore, or launch them afloat'.[103] He also refers to the use of capstans by the Portuguese.[104] Another instance of the use of the capstan in India in the seventeenth century comes from Goa in the 1630s, when Mundy saw a ship being launched into water with 'cables, capstans and a multitude of people'.[105] Next, Bowrey (1670s) enthusiastically refers to the launching of ships on the Coromandel coast with a sketch explaining how a ship was hauled for careening with tackles and capstans.[106] The information about its use during the seventeenth century at places which were intensely exposed to European techniques—Goa to the Portuguese, and Coromandel to the Dutch and English[107]—is perhaps a reasonable indicator of the real situation.

Sheathing

The seasonal attachment of layers of fresh planks to the hull of a ship as protection against sea-worms and leakage was quite

well known in China before the fourteenth century. The Europeans took it over in the sixteenth century.[108]

But do we have any evidence to show that this was practised in India before the coming of Europeans? The application of lime seems to have been a traditional method in India to preserve timber against pests which Europeans readily accepted,[109] but our sources do not help us much in reference to sheathing. It should have posed no problem to Indians since timber was in abundant supply, and the technique did not involve any complicated carpentry. Perhaps it may not have been very common because of the use of lime for the same purpose. At any rate, sheathing came to be practised in India on a large scale during the seventeenth century.[110]

Coming to metal sheathing, lead was occasionally used in European ships from 1670 till it was replaced by copper in 1761.[111] Pyrard says that the Portuguese used lead at the 'seams and joinings of the timbers' only. He further remarks that although this may be 'good against worms, preventing them piercing the timbers, yet for all that it clogs the vessel overmuch'.[112] However, no evidence is forthcoming that lead was adopted by Indians.

As for sheathing the rudder with copper plates, it was 'discussed' in China before the eighteenth century.[113] What is of interest is that in 1615 it was suggested at Tecoo by Walter Payton that rudders should be 'sheathed with thinne copper, to prevent the wormes eating off the edges thereof'.[114] We do not know whether it was actually done, but the suggestion itself may be a hangover of the Chinese 'legend' of bronze or copper sheathing[115] spreading to Tecoo. In India, however, it does not appear to have even approached the level of 'discussion' as in China.

Navigational Instruments

Telescope. During the seventeenth century, telescopes had come to be used as a navigational aid by European seamen. It was also used to 'spy' enemy ships.[116] The first clear documented evidence of its knowledge to Indians in North India comes from the reign of Jahāngīr when Sir Thomas Roe presented 'burning glasses and prospectives' (i.e. telescopes) to the Emperor.[117] In the same period, Āsaf Khān is reported to have taken interest

in telescopes along with spectacles and other such European devices.[118] In 1652, the English factors asked the Company to send them, among other things, telescopes as presents for Indians.[119] European pilots engaged by Indians must have been using the telescope for observational purposes. Despite such opportunities, we are told by the English in 1652 that little sale could be expected of such things.[120]

In 1703, when a number of glassware items, including telescopes, were offered for sale at Sūrat by English factors, only two telescopes were purchased by one Indian merchant, Rustamjī, while other kinds of glassware were found to be easily vendible among the Indians.[121] It seems that Indians received this item generally in gift,[122] but there is no evidence for its use by Indians either for navigational or astronomical observations during the seventeenth century.[123] That it was looked upon as an object of curiosity may be inferred from the fact that Tavernier (1666) presented a telescope to the ten-year-old son of Shā'ista Khān, the governor of Bengal.[124]

According to E. Maclagan, Rāja Jai Singh Sawai (1699–1743) of Jaipūr asked for maps, globes and books on astronomy from the Jesuits[125] when he built observatories in India. Maclagan does not mention telescopes. But Sir Saiyid Ahmad Khān indicates that telescopes were used by the Rāja and his team at the Delhi observatory.[126] If this was true, then, unfortunately, this fact was not known to the Indian lexicographer, Tek Chand, who, by the middle of the eighteenth century, refers to the twofold uses of telescope (*dūrbīn*): as an aid to pilots, and for reconnoitring the position of enemy soldiers.[127]

Compass. The magnetic compass which brought about 'a great revolution in the sailor's art' was probably used on Chinese ships since the eleventh century (A.D.), or even earlier, followed by the non-Chinese Asian sailors in the Indian Ocean.[128] But it is difficult to determine the extent of its use amongst Indians. In the mid-fifteenth century, Conti, an Italian traveller, tells us that the natives of India do not use 'the Loademans-stone as wee do', but measure their courses and distances by the elevation and depression of the Pole.[129] Fryer, writing in the 1670s, says that the Portuguese on their first arrival at Calicut found many ships, but without either a chart

or compass.[130] Perhaps it would be incorrect to wholly accept these two observations. It would however appear that Indian seamen might have used the magnetic needle,[131] but as Needham explains, and as corroborated by Conti above, they laid more emphasis on the determination of the position of stars with the aid of a sort of cross-staff called *kamal*.[132]

But what we wish to learn is whether the arrival of Europeans accelerated the use of the compass, a device already known in Asia, amongst Indians. Lack of clear evidence on this point during the sixteenth and seventeenth centuries leads us to conjectures only. In 1677, the English factors in Bombay complained that, among other things, compasses were not procurable, and they requested the Company to send some from England. They thought that, apart from their own use, surplus compasses with them might also be sold (to Indians) with profit.[133] It could be perhaps inferred from this that Indians did not manufacture compasses themselves. But, again, the extent of its use is not indicated. An amusing incident narrated by Bernier must be related here since it has some bearing on our inquiry. Bernier saw an illiterate 'half-caste Portuguese, a fugitive from Goa', sitting by a street of Delhi pretending to be an astrologer. He possessed an old mariner's compass which he confidently used as a tool for divination to deceive his customers.[134] This slight evidence is an indicator of ignorance of the real use of the compass among the common people.

We find ourselves similarly situated as regards binnacles,[135] lanterns,[136] etc.

Globes. Terrestrial globes were also used by Europeans aboard ships during the seventeenth century.[137] The English factors gave globes as presents to the Mughal Emperors, princes and nobles.[138] A globe appears as a symbol in a painting during the reign of Jahāngīr, showing an outline map of some Asian countries.[139] In 1639, Qutb Shāh, the ruler of Golconda, asked for a globe from the English factors, among other things.[140] But we have not met with any evidence of its use by Indians.

We do not know what time-keeping devices were used by Indians aboard a floating ship. The sinking-bowl clepsydra was known, but it could not have been used on a ship rocking on unstable waves.[141] Sand or hour-glasses were brought by Euro-

peans to India during our period,[142] but their use on Indian ships is not known.[143]

Viewed as a whole, there does not seem to have been any built-in resistance among Indians to innovations in the art of shipbuilding. As early as 1612, the ships at Dabul are reported to have been made 'Christian like, with topps and all their tacklinge accordinglie'.[144] It was remarked by the end of the first half of the seventeenth century that Indians had become so expert as to convert an Indian-built ship outwardly 'after the Christian manner' by fitting her properly.[145] During the 1670s, Bowrey stated with excitement about shipbuilding on the Coromandel Coast:

> Very Expert Master builders there are severall here who have most of their dependence upon the English, and indeed learnt theire art and trade from some of them, by diligently observeinge the ingenuite of some that built ships and sloops here for the English East India Company and theire Agents, soe that they build very well and give good reasons for what they doe, and lanch with as much discretion as I have seen in any part of the world.[146]

Fryer also spoke in the same vein about the skill of Indians in this sector and thought that they were 'beholden to the poverty of some English shipwrights'.[147] Again, in 1689, Ovington praised Indian 'ship-carpenters' at Sūrat who could build a ship after the 'Model of any English Vessell, in all the curiosity of its buildings . . . as exactly as if they had been the first contrivers'.[148] It is no wonder, then, to find an Indian having been employed in 1672 by the English Company as their chief carpenter at Sūrat to advise on shipbuilding.[149]

LAND TRANSPORT

Coaches

The only object of interest in this branch of transport is the horse-drawn wheeled-coach brought by Roe for Jahāngīr. The Emperor got into it by night, examined its 'every corner' and caused it to be driven about a little;[150] later, the Emperor presented it to Nūr Jahān, and, for his own use, had another made after the original design[151] by 'his workmen [who] first putting the English coach together, did so with that they had new made'.[152] Apparently, very soon more such coaches were

constructed at the Emperor's order,[153] one of which was given to Prince Khurram in 1617 as a present.[154] When Jahāngīr marched from Ajmer the same year, he sat in one of these drawn by four horses; he also asked some of his nobles to accompany him in similar coaches.[155] It appears that Jahāngīr's interest in European coaches was short-lived; consequently, his nobles also allowed their interest to languish. During the remaining decades of the century, we do not hear again of horse-drawn European coaches being used by any section of Indian society. A reference in 1632 that Shāh Jahān possessed twenty 'coaches', two of which were drawn by two horses each, and the rest by oxen, does not specify whether they were of the European style.[156]

But this does not imply that European coaches disappeared from India. Europeans used them but with a difference. Early in 1620, we are told that the English factors at Sūrat employed a 'bellwan' (*bailwān* = cart-driver) for their 'ould coach'.[157] In 1679, the 'Europe Merchants' at Sūrat possessed a few coaches, but they were drawn by oxen like Indian carts.[158] Again, the English President at Bombay (1670s) went about in his 'coach' pulled by large 'milk-white oxen'.[159] On the other hand, Thévenot indirectly affirms its use in Thatta when he says that 'they have but few coaches, because few Europeans go thither, and hardly any one of the Indians make use of coaches but they . . .'[160] Tavernier once had a carriage made 'after our manner' for which he purchased two oxen for six hundred rupees.[161] The English President at Sūrat (1689) used to go to a garden adjacent to the city in a large 'coach' drawn by 'a pair of stately oxen'.[162] But the use of European coaches drawn by oxen could have been possible only by adding a yoke for the oxen. However, we must point out here that at least in some cases cited above it is not clear whether the term 'coach' refers to the European or Indian vehicle. At any rate, the above examples establish that the Europeans did not use horse-drawn coaches or carts in India during the seventeenth century.

Indian carpenters were able to imitate this novelty so perfectly as to confuse Thomas Roe for a while in making a distinction between the original and its copy.[163] This easily excludes the plea of constructional difficulties involved. The traditional concept of comfort derived from sitting cross-legged in the Indian cart in contrast to riding with legs hanging down in the

European coach, which Fryer so intelligently observed,[164] may arrest the attention of an anthropologist who may like to explain it in terms of *motor* habits. In order to emphasize the importance of such *motor* habits, it will be appropriate to cite what Grose, an English traveller, noted in 1750:

> As to the palanqueens, they seem to me the utmost stretch of invention for humoring constitutional indolence of those people, as surely a more lazy conveyance could not well be imagined . . . At Calcutta in Bengal some of our gentlemen, probably disgusted with the reproachfully indolent attitude incident to this method of carriage, invented a new one, by which means the bedstead was converted into a platform, that supported a common chair well-fixed on it, upon which they could sit more decently and full conveniently under the canopied arch . . .[165]

In 1809–10, Francis Buchanan echoed the same note for Purnea:

> The carriages upon two wheels, after the native construction go very fast, but would be of little use to an European, as to the space for sitting is so small as not to admit of a chair or stool, so that the passenger must sit on his heels, which few Europeans can do.[166]

Besides, perhaps the cost of construction might have been a deterrent to the construction of such coaches for common use in India. The 'gallant caroch' that Roe brought for the Mughal Emperor was of '150 pounds price',[167] equivalent to about 1,333 rupees of that period.[168] Conceding that this particular coach was a present to one sovereign from another, even half of this amount would have been a very big sum for an average Indian.

What concerns us most is the indifference towards the art of harnessing horses to pull wheeled vehicles as a rapid means of transport. Manrique commented that 'instead of swift horses, they [Indians] attach in these parts halting, slow-paced oxen'.[169] Was this a very ancient practice in India?

We know that horse-drawn chariots (*ratha*) were used in India from the time the Aryans came to this country. The Mauryan army is said to have consisted of 6,00,000 infantry, 30,000 cavalry, 9,000 elephants and 8,000 chariots.[170] Later, the use of chariots during the reign of Harshavardhana (*d.* A.D. 647), at least as a basic wing of the army, becomes a little doubtful since Yuan Chwang's statement creates some serious

confusion. At one place he describes the wings of Harshavardhana's army as follows:

> The army is composed of Foot, Horse, Chariot, and Elephant soldiers. The war-elephant is covered with coat-of-mail, and his tusks are provided with sharp barbs . . . The chariot in which an officer sits is drawn by four horses, whilst infantry guard it on both sides.[171]

At another place, he says: 'Then having enlarged his [Harshavardhana's] territory he increased his army, bringing the elephant corps up to 60,000 and the cavalry to 1,00,000 . . .'[172]

It is remarkable that Yuan Chwang does not give the number of chariots in the latter statement, though he mentions chariots in the former. Could we say that chariots were being discarded gradually as the basic unit of the army? (But he does not mention the strength of the infantry either.) At any rate, when the Turks came to India, they were not met with chariots in battlefields. Perhaps chariots began losing their importance in war after Harshavardhana's reign.[173]

This is not the proper place to investigate the causes of the apparent disappearance of the horse-drawn *rathas*. But our interest is aroused when after a lapse of centuries horse-drawn carriages were again noticed in the second decade of the sixteenth century at Cambay.[174] During 1589–91, Emperor Akbar is reported to have driven a 'two-horse chariot' in which he sat 'with crossed-legs'.[175] Abul Fazl, at the end of the century, reinforces it by referring to *ghur bahl* (horse-drawn carriage), though not in the context of any particular region.[176] However, it is intriguing that a little before, when the *Ā'īn-i Akbarī* was compiled, an English traveller noticed fine carts with wheels being drawn by 'two litle buls the bigness of our great dogs in England' in the Āgra region, but he does not mention horse-drawn carts anywhere.[177] During the seventeenth century, for none of the regions, including Gujarāt, do we find any literary evidence on the use of horse-drawn vehicles. As late as 1689, Ovington at Sūrat remarked that 'their Hackeries likewise, which are a kind of coach with two wheels, are all drawn by oxen'.[178]

That most Indians were generally ignorant of the mode of harnessing a horse to a cart is ridiculously brought out in Mughal paintings. The artists of Akbar's court, while illustrat-

ing the *Razmnāma* (Persian translation of the Indian epic, the *Mahābhārat*), invariably depict the extinct horse-drawn *rathas* (chariots) of the Aryans with a yoke upon the necks of the horses,[179] taking their model from the ox-drawn cart. We are not certain how the Aryans in India harnessed horses to their two-wheeled *rathas*. For that matter, we are ignorant of the method of harnessing horses in medieval India too, although one can assume that the cattle-yoke was definitely not used for horses. The history of transport technology offers perhaps only one example of horses being attached to carts with yokes which were of a type generally used for cattle (cf. S. Bokonyi, *History of Domestic Mammals in Central and Eastern Europe*, p. 259). It is hardly necessary to point out the low efficiency and deficient performance of such vehicles. However, a slightly improved variety was also used in ancient times in which from each end of the yoke two flexible straps encircled the belly and the neck of the animal, almost suffocating him (cf. Lynn White, *Medieval Technology and Social Change*, p. 59). Again, in a Rajasthani painting (*c.* 1725–30), one detects the same notion of harnessing a horse to a wheeled-carriage.[180] In fact, the entire range of evidence on this point stands out as a denial of the use of horse-drawn wheeled-carriages during the seventeenth century as a *common practice* in India. Therefore, it is not surprising that the sketches drawn by Peter Mundy in the 1630s to represent 'Modes of transporting women in India' do not show horse-drawn carts or carriages at all.[181] Moreover, the Persian literature on horses, called *Farasnāma*, belies our expectations when it abstains from offering us anything on horse-drawn transport technology, though it contains enormous material on a variety of aspects relating to horses: for example, the art of ascertaining the age of a horse, the method of breaking in the horse, the technique of horse-shoeing, horse's diseases and cures, etc.[181a]

At most, we may concede that on very rare and particular occasions horses might have been used. For the early sixteenth century we are told that 'horse-carriages' were used in Cambay when women were 'brought forth from their houses' for travel.[182] Bernier tells us that the 'stirrup artillery' of Aurangzeb was conveyed on a small carriage pulled by 'two handsome horses'. The reason, he adds, was to carry it 'at a quick rate, so that they may be ranged in front of the royal tent in sufficient time to fire

a volley as a signal to the troops of the King's arrival'. (On the other hand, ponderous cannons were dragged by 'twenty yoke of oxen' with occasional help from elephants on steep or rugged terrain.[183]) Again, Abul Fazl says that leopards (for hunting) were carried in carts drawn by horses,[184] although no single painting illustrates this; instead, as he himself describes, the leopards have been depicted in the paintings being taken out either in a palanquin (*dolī*) lifted by human beings, or a wheeled cart drawn by oxen.[185] In fact, there is only one Mughal painting executed by Govardhan (during the reign of Shāh Jahān) which depicts a rustic scene (not hunting) in which an open two-wheeled carriage drawn by two horses has been shown. There are four persons, two sitting in the carriage, and the other two on saddled horses.[186] Here the artist does not make the mistake, like that committed by the *Razmnāma* painters, of putting a yoke on the neck of the horse. Govardhan's horse-drawn vehicle is real, and one wonders whether this could be of the type noticed by Mundy in 1632 as mentioned above, or of a type similar to that which Akbar is reported to have driven.

In 1612, Patrick Copland wondered that though 'they have store of goodly horses', Indians used oxen to draw their carts.[187] What, then, could have been the reasons for rejection of the horse-drawn cart in general? Fryer, while referring to the Europeans at Sūrat, explains that they yoked oxen to European coaches because they did not have 'Horses managed for the coach, or any skill'd [person] to drive them'.[188] Thus, the want of horse-trainers for this particular purpose might have been one of the reasons that discouraged Indians too. Besides, seeing that Europeans in India did not bother much about it, Indians were not stimulated by any feelings of emulation or competition since there was none. The manufacture of the horse-collar could have posed no problem to Indian artisans. But, perhaps, a good reason was, as Ovington observed: 'For the carriage of their goods, the Indians seldom make use of Horses, they are generally employed in the Moghul's service in war; but bring them to Suratt in waggons, upon Dromedaries, Asses, and camels.'[189]

Earlier, Fryer said the same thing, that is, 'Horses being only for war', and added, 'or pleasure'.[190]

From the Rajasthani painting (A.D. 1725–30) mentioned above, it may be inferred that even by the first quarter of the

eighteenth century the horse-drawn carriage was not a common sight in India. It was noted by Grose in 1750 that the 'equipage and carriages of the Moors consist chiefly in elephants, horses, palanqueens and hackrees'.[191] But he also adds:

> . . . in Bengal, I am told, the most eminent of the Gentoo-merchants have come into the use of horses and chaises, in which they are so fond of a parade, they know they may safely display under the English government; and which for fear of a fleecing they durst not do, under that of the natives, as to have them richly ornamented, and even the reins garnished with silver or gilt studs.[192]

In 1809–10, Francis Buchanan records the use of 'two-wheeled chaises [Ekka]' drawn by horses in the district of Shāhābād in Bihār.[193] For the district of Purnea in Bihār, he observes for the same period: 'One native keeps a coach made after the European fashion, and five keep buggies, while eight keep carriages of the country fashion drawn by horses . . .'[194]

The first pictorial evidence of the use of horse-drawn coaches comes from the brush of an English painter, Thomas Daniell, during the 1780s, whose album, 'Views of Calcutta', is lodged in the India Office Library, London.[195] Later, in 1840, Rām Singh II of Kota has been shown in a Rajasthani painting riding in an English carriage.[196] Thus, it could be said that by the end of the eighteenth century horse-drawn carriages were used in some parts of India on a fairly large scale.

MILITARY TECHNOLOGY

Naval Warfare

When, during the second half of the seventeenth century, Indian shipping increased on a large scale,[197] the English factors in Bengal lamented: 'these people are growne more powerfull then formerly, and will not bee so subject to us as they have byn, unless they bee a little bitten by us . . .'[198]

Undoubtedly, Indians could have beaten Europeans in peaceful trading competition unless 'bitten' by the latter; and indeed they quailed when confronted with European armed might on the high seas. To illustrate this, we have selected two incidents: one from each half of the seventeenth century. Before we describe these two incidents, we may mention *en passant* that a study of Mughal paintings has so far yielded only two naval

engagements: first, the battle between Bahādur Shāh, the ruler of Gujarāt, and the Portuguese;[199] the second depicting the Mughal assault on the Portuguese settlements at Huglī during the reign of Shāh Jahān.[200]

In 1625, a naval encounter took place between an Indian junk (owned by Khwurd Mahmūd, a merchant of Sūrat) and the *Scout*, an English ship. The former was of 250 tons with twenty 'peeces' of artillery, sixty small 'shott' and ten 'harqubushes', while the latter was of only 25 tons with two 'peeces' of artillery and eight small 'shott'. Again, the former had 250 men as against 22 'men and boyes' aboard the English ship. It was discovered at the end of the encounter that the English had killed eleven Indians and injured one; on the other side only one Englishman was hurt. The English rightly boasted that this happened despite the fact that the Indian vessel 'by computacion in all things . . . had ten to one'.[201] The other incident occurred in 1694 when Aurangzeb's biggest ship, *Ganj-i sawā'ī*, fell an easy prey to one English ship without even being able to engage in proper combat. The Mughal ship was armed with 80 cannons and 400 muskets, while the English vessel was much smaller in size and had less than one-third or one-fourth the arms and ammunitions carried by the former.[202]

Both the examples show that neither the size of the ships nor the number of men and weapons was of any advantage to the Indians. There are innumerable references to the use of artillery on Indian ships, especially during the seventeenth century;[203] but this did not impress Europeans who made adverse comments on the skill of Indian gunners. In spite of long association with Europeans, we meet with the recurrent refrain that Indians 'cannot well defend themselves',[204] or 'they do not know [how] to handle them'.[205] In the 1670s, Fryer remarked that '. . . some of their ships carry 30 or 40 pieces of cannon, more for show than Service . . .'[206] Thus, it was not for the want of guns, at least in the seventeenth century, that Indians suffered humiliation on the high seas: their weakness lay in their lack of skill in using guns. Van Twist in the 1630s commented that 'though they carry many guns, they are not protected by them, for [the guns] are on the top orlop without defence'.[207] It is difficult to establish the existence of gun-ports in Indian ships in the first half of the seventeenth century; it was only in the later

decades when they seem to have been adopted.[208] But we have no evidence of chase-port or sterne-chase in Indian ships.[209]

If Terry's remark that Indians took too long in taking aim,[210] and Bernier's that a bowman could shoot six times before a musketeer fired twice,[211] are allowed to be transferred to naval warfare, perhaps the failure of Indian seamen in this sector may be partly explained. They also appear to have been inexpert in manoeuvring their ships as Fryer says that they 'managed their sails but awkwardly, and are unskilful in Martime Affairs . . .'[212] Undoubtedly, European seamen had gained experience in naval warfare in their own waters, while Indians had nothing comparable to show before the former's arrival. We may cite here an incident narrated by Manucci. When Aurangzeb wanted to prepare an imperial fleet, it was put to him that he had no proper 'men to direct it'; whereupon the Emperor said that the task might be entrusted to the 'Franks who lived on his pay'. It was again represented that it was unwise to 'confide to foreigners . . . [who] might easily abscond . . . the Moghal soldiers . . . not being properly trained, would allow themselves to be completely controlled by those commanders'.[213] As a proof of European skill, an ocular demonstration was held by an Italian with a small ship fitted with 'sails and rigging, guns and flags' which was launched on a great tank. In the words of Manucci:

> Here the European artillery men, accustomed to navigation, went aboard the vessel, and caused it to move in all directions by adjusting the sails and working the helm with great dexterity and cleverness. Thus, as if engaging some other man-of-war, they discharged the cannon, turning in all directions. On seeing this, after reflecting on the construction of the boat and the dexterity required in handling it, Aurangzeb concluded that to sail over and fight on the ocean were not things for the people of Hindustan, but only suited to European alertness and boldness. Thus at last he abandoned the project entertained with such obstinacy.[214]

Manucci is wrong in concluding that this ocular demonstration deterred the Emperor from building a fleet, but the whole account well demonstrates the contemporary assessment of Indian shortcomings in naval encounters. As for the imperial fleet,[215] it consisted of two men of war, each of 300 tons with 1,000 men aboard both the ships, which sailed for Bombay from

Gogha in November, 1682. Later, we are told that 'after some small Disputes at Sea, at which the Indians are never vigorous, the Mogul attempts the sending a Land-Army upon Bombay . . .'[216] This fits in quite neatly with what Fryer said:

> And if the King's fleet be but ordinary, considering so great a Monarch and these Advantages, it is because he minds it not, he contenting himself on the enjoyment of the continent and styles the Christians Lions of the sea, saying that God has allotted that unstable elements for their Rule.[217]

Before we quit the naval arena, reference may be made to the use of grappling-irons, an implement for laying hold of the enemy's ship to prevent her from fleeing. Marco Polo, while describing the method of piracy of the Mālābār buccaneers, does not refer to its use by them.[218] The first mention of its use comes from Varthema (1503–8) who says that the Portuguese employed it in an encounter near Calicut.[219] The first documented instance of grappling-irons used by Indians is during the concluding decade of the seventeenth century.[220]

Fire-arms

Many decades ago, some scholars, both European and Indian, were keen to prove that gunpowder and fire-arms were used in ancient India.[221] Among the ancient sources, *Sukranīti* became the focal point from which support was drawn. However, sobriety and maturity prevailed when other scholars dismissed their inferences, especially after a careful examination of *Sukranīti*.[222] Again, untenable attempts were also made to show that the Muslims who came to India following the invasions of Sultān Mahmūd of Ghazna used fire-arms.[223] Recently, it has been ably shown that gunpowder may have been used in India for the first time in the thirteenth century, and more definitely, in the fourteenth century—not for propelling cannon-balls, but for pyrotechny.[224] It has been further suggested that fire-arms (in contrast to fire-weapons) may have been used for the first time during the second half of the fifteenth century in some regions of India (Gujarāt, Mālwa, Kashmīr and the Deccan).[225] Although evidence for the latter inference appears somewhat slender, it may be conceded that perhaps Indians in some regions were familiar with some crude forms of fire-arms. Nevertheless, the use of fire-arms on a regular basis was introduced by

the Portuguese, initially in the south, and by Bābur, the founder of the Mughal Empire, in the north, in the early sixteenth century.

The main source of European impact during the sixteenth century was largely through the agency of the Portuguese. It is not certain whether fire-arms were common currency on the Mālābār coast before Vasco da Gama, but their use must have been known there.[226]

That the Zamorin of Calicut should have paid great attention to fire-arms is not surprising, for Calicut had become a bottleneck to Portuguese designs, and had in consequence to pay a heavy price. As early as 1502, an eye-witness stated that the Zamorin had two pieces of cannonry in position, though inferior in quality, and those who manned them were adept neither at aiming nor reloading. In 1503, some iron guns were used by his men which could project stones 'as hard as a man could throw them'.[227] He must soon have realized that all this was merely a minor sting to a giant; hence efforts were made to learn the art from Europeans directly. Varthema has preserved an account of the two Milanese who were weaned away from the Portuguese to manufacture ordnance for the Zamorin. He writes:

> . . . they had made between four and five hundred pieces of ordnance, large and small . . . not only did they make the artillery themselves, but they also taught the pagans to make it; . . . moreover, that they had taught fifteen servants of the King to fire *spingarde* . . . they gave to a pagan the design and form of a mortar . . . of metal. There was also a Jew here who had built a very beautiful galley, and had made four mortars of iron.[228]

Again, Castanheda writes that four Venetians came to Mālābār in 1505 to cast guns.[229] It is no wonder, then, to find the 'moors' at Cannanore using 140 pieces of artillery in a naval battle against the Portuguese.[230]

The policy of the Zamorin to employ Europeans served as an example to many rulers in India, especially when other European nations started coming to the country during the seventeenth century. Speaking of the Mughal army, Bernier refers to '. . . their artillerymen who receive great pay, particularly all the Franguis or Christians,—Portuguese, English,

Dutch, German, and French; fugitives from Goa, and from the Dutch and English Companies'.[231]

Earlier, Jahāngīr refers to a European, Mansūr Khān Faringī, who detached himself from Prince Khurram when the latter rebelled against his father: Jahāngīr gave him the rank of 4,000 *zāt* and 3,000 *sawār*.[232] Careri describes his meetings with Europeans, especially the French, in the 'Christian Gunner's Quarter' in Aurangzeb's camp.[233] Mīr Jumla is reported to have taken the fort of Gandikot with the help of French, English, Dutch and Italian gunners.[234] When Manucci learnt that Prince Dārā wished to employ him, he rejoiced at the news because he was told that 'Europeans who served this prince had a good life of it, and received adequate pay.'[235] The men of the Siddī of Janjīra, who attacked the Bombay fort with devastating effect, were alleged to have been taught the 'art of mineing, and sheltering themselves in their trenches and Basket-works' by deserters from the English forces.[236] A European eye-witness states that they learnt the use of mortars also from the same source.[237] Later, the witness himself accepted employment in Bengal as a 'commander' of 100 European soldiers in the Mughal army.[238] Shīvājī is reported to have attempted to blow up the castle of Sūrat by detonating a mine with the help of 'an European Engineer'.[239] Prince Murād Bakhsh enlisted the help of Dutch miners to blow up the walls of Sūrat fort.[240] Bowrey noted about Golconda:

> Many Europeans, Especially of our English Nation, are here become inhabitants, Entertained in the King's service, and are for the most part in one office or other, accordinge to their deserts, as Gunners, Gunners Mates, Armorers, and some troopers, and have considerable Sallary, which hath Encouraged many English Soldiers of Fort St. George's to flee their colours, and hasten thither . . .[241]

The purpose of these selected examples is to give an idea of the widespread practice of employing Europeans to handle fire-arms, etc. Indeed, so great became the extent that Prince Dārā is known on one occasion to have deprived Mīr Jumla of the eighty European artillerymen in his service through bribery.[242] Shā'ista Khān did the same to win over European naval officers of the King of Ārākān.[243] It is natural for us to expect that exposure to European gunners and sappers over such a long period must have imparted considerable skill to their Indian

counterparts. Perhaps the exact degree of skill so acquired by the Indians cannot be gauged; nevertheless, some indications are available. Bernier remarks:

> Formerly, when the Mogols were little skilled in the management of artillery, the pay of the Europeans was more liberal, and there are still some remaining who receive two hundred roupies a month; but now the King admits them with difficulty into service, and limits their pay to thirty-two roupies.[244]

The reduction in salary is corroborated by Fryer who notes: '. . . formerly for good pay, now very ordinary, having not above 30 or 40 Rupees a Month'.[245] Later, Careri paraphrases Bernier, and then adds: 'Some of them formerly had 200 roupies a Month, but now the Moghuls have learnt somewhat of the Art they have less.'[246]

Thus, the scaling down of Europeans' salary in Mughal service has been ascribed by Bernier and Careri to the declining dependence of Indians on their skills, Indians having somewhat improved their own. But Bowrey, on the other hand, sings a different tune in regard to Golconda. He notes that European artillerymen 'now-a-days are but ordinarilie respected or Entertained by theire debauched and unchristian like behaviours'.[247] This gets strong backing from Manucci who says that Aurangzeb, immediately after his coronation, deprived European gunners of all their privileges except that of distilling spirits. The reason: their insolent behaviour and drunkenness. He forced them to do sentry duty like other soldiers, 'thus leaving them with no estimation or reputation in the army'.[248] That these measures of Aurangzeb did not result in any salutary disciplinary effect is clear from what Careri records. When the latter went to meet the Christian gunners in Aurangzeb's camp, he was told by them that 'it was a pleasure and Diversion to serve the Mogul, because they that will not fight, or do not keep their guards are subject to no other Penalty, but losing that days pay . . .'[249] All this may lead us to infer that it was the lax discipline among Europeans that caused reduction in their pay. Most probably both the reasons contributed, though one may suspect the degree of skill acquired by Indians in taking aim. As Manucci observed, European artillerymen in Mughal service 'had only to take aim; as for the rest—the fatigue of raising,

lowering, loading, and firing—this was the business of artificers or labourers kept for the purpose'.[250] Such continued heavy reliance on Europeans is not a favourable indicator. In 1666, the English factors doubted that Aurangzeb's Indian soldiers could handle cannons and mortars on their own.[251] The case with 'light' guns was similar.

Bernier notes that Indian musketeers were 'terribly afraid of burning their eyes or their long beards'.[252] Thévenot thought that the Indian matchlockmen were 'timid and unskilful in firing'.[253] We should also consider that while our sources speak of reduction in European soldiers' pay, they do not refer to any reduction in the number employed in the Indian army.

So far we have been dealing with only one aspect of the process, in which Europeans were employed to handle artillery; now we propose to take up yet another aspect—attempts to engage them as 'manufacturers'.

We have described above the Zamorin's employment of Europeans to make artillery pieces. Coming to the Mughals and others, it is significant to notice that almost all our relevant information comes from the second half of the seventeenth century. Mīr Jumla is reported to have had in his service a certain Maille, from Amsterdam, to establish gun foundries.[254] In 1663, he employed Thomas Pratt, an Englishman, to build boats and manufacture ammunition in Bengal.[255] In 1666, Aurangzeb asked the English factors to send him 'five gunfounders and two engineers or pioneers'.[256] More definite evidence comes from the last decade of the seventeenth century in Bengal where, we are told, a priest of the Augustine order had established an armoury for the Mughal army with enough weapons to arm six hundred men. The armoury consisted of 'carbine, bayonet and granado', besides a vast number of stink-pots being supplied from the four or five forges in his 'yard . . . so that he hath in a manner quite turned the Church into an arsenal'.[257] Simultaneously Indians were also purchasing arms and ammunition from the Europeans. In 1618, we find the Dutch selling some brass ordnances to the Indian authorities.[258] Around 1644, the English factors at Sūrat sent one of their ships to Bassein to fetch some great guns made there for a new junk built for the 'princesses accompt' (Princess Jahān Ārā'?).[259] We encounter a number of references relating to the period between

1644 and 1660 to the sale of English guns and cannons to Indians.[260] Later in 1666, the English factors struck a deal with Aurangzeb to sell him several large brass guns, besides mortars and shells.[261]

Could these two concurrent processes, that is, the employment of Europeans to forge guns and the purchase of European guns and shot, indicate that after a long association, Indians might have made some advances in learning the European techniques? Let us take one or two items to assess the Indian response.

'Harquebus' or arquebus, a small portable handgun fitted with a matchlock,[262] was in use in Europe at the beginning of the sixteenth century. It is uncertain whether matchlocks were introduced into India first by the Portuguese or by the Mughals. The Indian *bundūq* ('bonducos') has been identified with arquebuses and similar handguns.[263] Manrique commented that 'those who carry fire-arms in their army are matchlockmen and people of no rank, known as tufangis'.[264] We hear of the use of arquebuses by Indians in 1625 in a naval battle.[265] A few years later, Indian soldiers ('sipahis') were observed carrying arquebuses which 'being poorly made, are as it were, awkward arms'.[266] We are not told the precise nature of the awkwardness, but it was noted that the Indian soldiers were so 'inexpert with their arquebuses that they had no effect'.[267] Does this indicate that even by the first quarter of the seventeenth century Indians were not quite used to matchlocks?

To what extent European matchlocks left their impression on the Indian ones we do not know. The case of matchcords is similar. The European cord was made of hemp or flax 'boiled in old wine dregs or in a solution of wood ash and saltpetre'; if well made, four or five inches of their cord would glow for an hour.[268] The Indian cord has been best described by Pyrard, and it is worth quoting him at length:

> Of the same substance [coconut husk], too, are made matches for arquebuses; it keeps alight well and makes good charcoal, better indeed than ours; but in making matches it is prepared differently from the rope: for the husk or shell must be dried with the fruit, and not plucked green, nor steeped, nor beaten, and the fibre is spun and twisted . . . When they have made their match, they boil it with ashes, as we use here; then they fold it together into thick hanks, like rings,

of the thickness of an arm; through these they thrust their arm when they are carrying their arquebuses. They never cut it, but merely snuff it as it burns away, as we do candles . . . however, where cotton is common and cocos scarce, they make their matches of cotton.[269]

As far as we know, no such detailed account is available for the later period, and therefore no inference could be drawn about the interaction between the two types of cords. We can only say that the Indian response may have been indifferent and parallel to what happened in the case of ropes (see above). We also draw a blank when we turn to look for evidence relating to breech-loading: the Indians continued with muzzle-loading.[269a]

Anyway, it is curious that Akbar's arsenal is reported to have been making guns (1595) in which the use of the 'match' (*fatīla*) was dispensed with.[270] Most uncomfortably, Abul Fazl is silent on the alternative mechanism employed. Europe knew two alternatives: the wheel-lock (with pyrites) and the flint-lock (with flintstones) which began to be used by the 1520s and 1620s respectively.[271] If Akbar's arsenal produced the flint-lock in 1595, it obviously did not owe anything to Europe. But Indians in the north are said to have been scarcely familiar with this mechanism during the early decades of the seventeenth century.[272] During the same period (i.e. 1620s), a foreign traveller recorded about the Zamorin of Calicut·

> The King saw that a Souldier of ours had one of those Arquebuses which the Portugals call Baccamarti, which are very short, of a large bore and with a flint-lock after the English fashion . . . The king taking the Arquebuse in his hand . . . look'd much upon the Flint-lock as a thing unknown to them, for their guns have only matches . . .[273]

These observations do not lend support to the use of flint-locks in India at least during the first half of the seventeenth century. In the case of the wheel-lock, it must be pointed out that it was a very delicate and expensive mechanism seldom used for arquebuses and muskets: it was generally used for pistols in Europe.[274] Indeed, there is no evidence to establish the introduction of European handguns mounted with wheel-locks into India. It may be suggested that perhaps the Mughal arsenal produced what was called a snaphaunce lock—the precursor of the flint-lock on the one hand, and on the other one step ahead of the snapping matchlock.[275]

At any rate, Abul Fazl's claim of the manufacture of handguns without the use of matches in the Mughal arsenal should, for the present, be considered an 'accident' in the history of Indian weaponry. Whatever alternative might have been adopted, it seems that these handguns were produced on a limited scale, probably for Akbar's personal use.

Nevertheless, in the 1660s, Bernier remarks: 'Sometimes they imitate so perfectly articles of European manufacture that the difference between the original and copy can hardly be discerned.'[276] He then goes on to give examples by saying that the Indians make excellent muskets and fowling-pieces.[277] This matches Tavernier's statement about Golconda that the barrels of 'their muskets are stronger than ours', because Indian iron is 'better and purer' which makes them 'not liable to burst'.[278] Could we deduce then that Indians had learnt to manufacture handguns with flint-lock during the second half of the seventeenth century? But Mughal paintings do not support this deduction.

Further, since the musket was heavier than the arquebus, it had to be rested on a fork.[279] It was only towards the end of the seventeenth century in Europe that the use of a rest was abandoned because the guns had become 'more streamlined, better designed and slightly lighter in weight'.[280] In India, the earliest evidence on the use of a rest for handguns comes from the early seventeenth century.[281] But the Indian fork was smaller than its European counterpart: the latter was used for firing in a standing position in contrast to the Indian 'squatting' posture.[282] Bernier's account shows the use of wooden forks by Indians in the 1660s, but he comments that the musketeers 'cut a sorry figure' even with these rests.[283]

Depicting hunting-scenes, some Mughal paintings show the long barrel resting on the shoulders of a man, instead of a fork, while the hunter aims at the quarry.[284] In one painting, however, the hunter has been depicted using a rest.[285] It can be suggested that the use of the 'human' rest for hunting was dictated sometimes by the nature of the hunting venture when a slight unguarded movement might scare away the prey: the animate support had greater mobility than the wooden one.

It may be pointed out here that the use of a support or rest for heavy guns in India, in fact, predates that for handguns.[286]

Another piece of weaponry which came from Europe was the pistol, which seems to have been used in Europe since 1547. The pistol was smaller than the arquebus, and was also different in that it was triggered by a wheel-lock, a very delicate and expensive mechanism which was seldom used for arquebuses and muskets.[287] This item does not find a place in the *Ā'īn-i Akbarī*. Irvine states that 'The pistol was in use in India, to some extent, at any rate, early in the eighteenth century'.[288] His opinion that it was unknown in India before the eighteenth century is incorrect. As early as 1608, the Portuguese are reported to have carried it to Sūrat.[289] In 1633, a curious newly invented pistol that served also as a 'walking-staff', was sent from England to the English President at Sūrat.[290] In 1639, Mandelslo gave 'a fine pocket-pistol made in London' to Mirzā Beg, a leading merchant of Cambay.[291] In about the same period, Manrique's pistol was examined by Indian soldiers as something novel.[292] Manucci tells us that a Dutchman presented Prince Dārā with a pistol, all inlaid with mother-of-pearl, and 'one that had never been known to miss-fire'.[293] This pistol was borrowed by Farīdūn, a servant of Dārā, to kill Jīwan Khān with whom the Prince had taken shelter in Sind when pursued by Aurangzeb's army, and who later conspired to capture Dārā and hand him over to Aurangzeb. But at the critical moment, the weapon which was known not to 'miss-fire', failed to click in the hands of Farīdūn.[294] Again, Tavernier gave a pair of pistols, inlaid with silver, to the ten-year-old son of Shā'ista Khān, the governor of Bengal.[295] He also gave a pair of pocket-pistols decorated with silver to an officer of Mīr Jumla in Golconda.[296] The English factors in 1683 presented a 'screwed' pistol to Kār Talab Khān, the governor of Sūrat.[297] In the 1660s and later, pistols were quite well known on the Coromandel coast,[298] Bombay[299] and Bengal.[300] Thévenot includes the pistol, in the second half of the seventeenth century, among the 'offensive' arms of the Mughal army along with bows, arrows and javelins,[301] although this is not borne out by the Persian sources. However, there is no evidence that Indians manufactured pistols themselves.

The use of shells, grenades and stink-bombs appears to have caught the eyes of Indians, especially in the latter half of the seventeenth century. Perhaps these items were more useful on

the high seas than on land, as we are informed by Manrique that they were 'used by the Portuguese in India in naval engagements, when grappling with the enemy'.[302] That is why we find the Mālābārīs fully acquainted with these weapons in sea-fights. It may be pointed out that the Portuguese are said to have adopted them in 1508 from Egyptian seamen.[303]

However, their use on land continued to be comparatively less familiar to Indians in the early decades. Manrique in the 1630s states that 'these sulphurous contrivances' were 'quite new and extraordinary inventions' to them, and for their benefit he arranged a 'tamasha' in an orchard which struck great terror into the 'whole of the timid assembly'.[304] While Shāh Jahān may not have shown much interest in this branch of artillery,[305] Aurangzeb is reported to have purchased 2,000 shells at 38 rupees per maund in 1658 from the English factors at Sūrat.[306] Again, in 1666, he was fervently expected to buy mortars and grenades from the same source.[307] In the 1690s, grenades and stink-pots were made for the Mughal army in Bengal by a European priest.[308] We have already referred to the use of mortars learnt from the English deserters by the men of the Siddī of Janjīra when he assaulted Bombay. Thus, it is undeniable that the Indians used these new weapons occasionally in different parts of the country at least in the second half of the seventeenth century. But the art of manufacturing them does not seem to have been grasped by Indians; even their use had not become a universal practice. Perhaps, as Irfan Habib opines, the reason may have been that the Indian armies possessed an alternative weapon in the *bān* made of bamboo with iron cylinders containing combustible materials.[309] Nevertheless, the comparative effectiveness of the two is disputable.

From grenades, shells, etc. we pass on to gunpowder. Early in 1616, an English traveller thought that Indian gunpowder was very good.[310] But this opinion is contradicted in 1623 by the English factors at Masulipatam; they stated that though the Dutch made use of some powder for current needs, they essentially relied upon its import from Holland for purposes of storage because, as they point out, 'the other will not keepe, for being ill-corned it growes all into clodds'. They also added that had it been good, there was no reason why the Dutch should have carried a large quantity of saltpetre home every year from

Pulicat.[311] Again, in 1628 the English factors at Sūrat wrote to the Company: '. . . for wee are assured that in noe part of India is made so good powder as is made in England, neither by the Portugalls themselves, much lesse by the heathens and Indians in theise parts'.[312]

A little later, Manrique expressed dissatisfaction with the native product which Indian soldiers carried in 'horn-shaped flasks', and he gave instructions to refine the 'heavy ancient-looking' powder.[313]

It has been observed that so long as the powder was quickly used, 'lack of proper refining or of expert manipulation did not greatly matter'.[314] The problem was whether the powder could retain its quality in storage for a long time. In 1744, when a test of all gunpowder in store, made since 1738, was carried out at Bombay by the English, it was found out that while the European powder had a range of 514 feet, the Bombay powder had a range of only 56½ feet.[315] The efficient performance of powder required good refined saltpetre, and skilful mixture of the ingredients. Indian powder-houses were mat or straw sheds where women and boys did the grinding by hand and foot with wooden pestles and mortars, and the ingredients were sifted in leather sieves.[316] The Dutch and French made powder at their settlements in India under the supervision of their own men, but we do not know whether they employed any improved technology, at least during the seventeenth century. The English, however, are said to have copied the 'crudest' method of 'native powder makers' for a long time.[317] They even employed an Indian chief powder-maker along with Europeans, till as late as the 1790s.[318] The English Company repeatedly asked for a skilled and expert powder-maker from England, but it appears that none was sent during the seventeenth century.[319] It was only after the 1740s that models of English powder mills were sent from England to the English Company. The machinery and material consisted of rolling and pilon mills, iron cylinders for grinding saltpetre, copper and iron boilers.[320] The real change came in 1754 when buffaloes were substituted for manual labour in working the mills, and this continued until 1863 when the first steam mill was successfully erected in Madras.[321]

Thus, Indian powder-makers do not seem to have had an

opportunity of improving the quality of their product to match that of European powder during the seventeenth century.

Swords etc.

Before we take leave of this section, we may touch upon one or two minor additional aspects of military technology. The European accounts show Indian preference for crooked swords in contrast to the straight ones in general use in Europe along with other types. That is why it was noted in 1614 that 'streight swordes' could not be sold at Sūrat.[322] The English factors asked their Company early in the seventeenth century to send one or two thousand crooked swordblades 'of this country fashion' for sale and presents.[323] Terry in 1612 noticed that the Indian curved swords were very sharp, 'but for want of skill in those that temper them, will break rather then bend'.[324] Indians wanted swords with a better quality of metal so that they did not break when bent.[325] To meet this demand, the English furnished them with English swords at high prices that will 'bow and become streight againe'.[326] In the 1660s, Thévenot tells us that 'the swords made by the Indians are very brittle', and consequently the English brought 'good ones' from England.[327]

However, there is evidence of the occasional use of rapiers by Indians. For example, Tavernier narrates the story of some wandering hermits who came to Sūrat armed with long rapiers which, in his opinion, had been procured by them from some Englishmen or Portuguese.[328] He also notes that in Golconda 'they do not have a sabre like the Persians, but they carry a broadsword like the Swiss, with which they both cut and thrust'.[329] The Marathas are reported to have taken a liking to the straight two-edged swords in contrast to the preference for curved blades on the part of 'Turks and Persians'.[330] In fact, the Marathas purchased European blades, especially German, Genoese and Spanish, though the hilts were frequently indigenous.[331]

The Indian curved sword did not however prevent its wielder from showing dexterity in battle. Olafsson is quite sure that Indians are 'surprisingly skilful in the use of arms, both with swords with curved blades . . . and with their spears'.[332] One weakness of the curved sword is, however, recorded by Fryer. When asked to explain the utility of a European rapier in actual

battle, he said that since the European custom in war was to appear 'all armed cap-a-pee', the Indian sword might not be of much use whereas the 'sharp-appointed weapons would pierce the junctures of the Harness, or the pleats of a coat of Mail'.[333] Again, Tavernier stated that the European method of point-fence was unknown to Indians.[334] Rawson elaborates that 'Indian swordmanship seems to have developed in the direction of a pattern of purely cutting strokes combined with acrobatic avoidance devices'. He adds that Indian swordmanship seems never to have made use of the point or much use of guarding with the sword. Parrying was done with a shield.[335]

THE PRINTING-PRESS

It is amazing that the Chinese knowledge of wooden-block printing did not evoke even a ripple of response in India during the period under study in spite of frequent communication between the two countries in the past.[336] It was only sometime during the early eighteenth century that block-printing is reported to have been occasionally resorted to in Bengal.[337]

European movable metal types[338] were brought to Goa around 1550 by the Portuguese, and in 1556 a Portuguese missionary, Juan de Bustamante, started operating it.[339] The Portuguese policy of making converts was largely responsible for the printing at Goa which turned out books on catechism, lives of Christian saints, sermons and also grammars and vocabularies. It was rightly concluded by the Portuguese that the most effective proselytizing, especially among the literate groups, would be through the mother-tongue of the people. This resulted in the printing of books in the Marathi and Konkani languages and dialects, but in Roman script rather than in the Devanagari or Marathi scripts.[340] Nevertheless, the first Indian script of which types were prepared was Tamil,[341] and the first book in the Tamil script was printed in 1578. It is however true to say that the number of such Tamil books printed by the Portuguese during the period under review was so small that it could hardly have made any impression on Indians. In fact, books printed by the Portuguese were predominantly in the Roman script. Without going into the political motives of the use of the Roman script,[342] it could be said that the technical

difficulties of type-casting, at any rate, in the sixteenth century, might have been one of the reasons for not printing books in Goa in the Konkani or Marathi scripts. Gonsalves, a Spanish ironsmith and clockmaker at Goa, who contrived the matrices of a few 'Malabar' (Konkani?) types in 1577, is said to have given up the idea on account of the 'uncouth shape of the letters'.[343] But some Jesuits did not think this problem insurmountable. In 1608, Fr. Stephens wrote to the head of the Society of Jesus from Goa:

> . . . for many years I very strongly desired to see in this Province some books printed in the language and alphabet of the land, as there are in Malabar with great benefit for that Christian community. And this could not be achieved for two reasons: The first because it looked impossible to cast so many moulds amounting to six hundred, whilst the characters are syllables and not alphabets, as our twenty-four are in Europe. The other because this holy curiosity could not be put into execution without the order and concession of the Provincial . . . The first difficulty has its remedy in this that these moulds can be reduced to two hundred. The second will vanish if your paternity thought it fit to write to the father Provincial, recommending him that he may do it if he feels that it will be for the greater glory of God, and edification and benefit of this Christianity.[344]

That this plea of Fr. Stephens did not make any impression on the Superiors at Rome is not the main point. What perturbs us is the total indifference of Indians in Goa in this matter. This lack of interest had gone to such a length that in the entire range of literature printed at Goa in the Portuguese or Indian languages during the period under review, not a single contribution came from Indians, not even from the converts.[345] However, there is a reference to an unnamed person, of Indian origin, who was sent to Goa by the King of Portugal to assist Bustamante in setting up the press there, and who was reported to be 'competent in press work'.[346] But, then, he was not an Indian 'citizen'.

On the other hand, it is surprising that none of the European nations, except the Portuguese, established a press in India during this period. The printing press at Bombay was imported from England by the English Company (1674–5) in compliance with the request of Bhīmjī Parak (see below). There is no evidence that any book was ever printed at this press, except

perhaps a few loose sheets in English.[347] Even the Portuguese press was 'localized' in South India.

Coming to the north, Indians were deprived of direct exposure to the printing-press, but they did have several opportunities of coming into contact with printed materials from Europe. The first Jesuit mission to Akbar in 1580 presented him with seven volumes—out of eight—of Plantin's polyglot Bible[348] printed in five languages—Hebrew, Greek, Aramaic, Latin and Syriac.[349] Akbar had acquired a large number of printed books from Europe which were lodged in the imperial library for fifteen years when, in 1595, he gave away a few of them to the third Jesuit mission, along with the volumes of the polyglot Bible.[350] It is unfortunate that we do not have any record of response at Akbar's court to the art of printing. It did not awake an iota of curiosity even in Fathullāh Shīrāzī, the much admired 'scientist'[351] at the court who served Akbar from 1583 to 1588. Jahāngīr, however, did take some interest. In 1606, at Lahore, the Emperor is reported to have expressed doubts about types being cast in the Persian script during a discussion with the Jesuits, whereupon the latter promptly dispelled them by showing him their copy of the Arabic version of the Gospels which they had obtained from an Italian in 1604 at Āgra.[352] This was probably one of the copies printed in 1591 at the Vatican.[353] But Jahāngīr's interest evaporated quickly since we do not hear of this topic being raised again.

Many books were printed at Leyden in the Arabic and Persian scripts, especially during and after the 1630s. For example, Father Jerome Xavier's works in Persian were published in 1638 and 1639, and there is every reason to suppose that these and other books were in circulation in India. A book in Arabic published in 1649 on theological refutation of some Islamic work was distributed in India. When it was brought for propaganda to the court of Shāh Jahān in 1651, his Wazīr, Sa'dullāh Khān, refused to accept it.[354] We have much evidence to show that such printed works in both Persian and European scripts were available to a large number of literate persons belonging to various sections of society during the seventeenth century.[355] We are told that the English factors at Sūrat maintained a library in their chappel which housed many printed books including the six volumes of Walton's London polyglot

Bible[356] published in 1654–7 in nine languages.[357] The factors tell us that many 'learned amoungst these people' hold the several volumes of this Bible in great esteem, and whenever any 'eminent person' comes to their house 'his great desire is to see the Chappel' where the library was established.[358] Visitors to the English factory at Sūrat must have included Mughal officials and individuals from the mercantile class.

And it was from the mercantile class that, many decades after the reign of Emperor Jahāngīr, another Indian, Bhīmjī Parak, the chief broker of the English company at Sūrat, showed an intense and serious interest in the art of printing. The English factors wrote to the Company on 9 January 1671:

> Bimgee Parrack makes his humble request to you: that you would please send out an able printer to Bombay for that he hath a curiosity and earnest inclynation to have some of the ancient Braminy writings in print and for the said printers encouragement he is willing to allow him 501 sterling a year for three years, and also to bear the charges of tooles and instruments necessary for him, and in case that will not be sufficient he humbly refferrs it to your Prudence to agree with the said printers according as you shall see good; and promises to allow what you shall enorder. It is not improbable that this curiosity of his may tend to a common good; and by the Industry of some searching spirrits produce discoverys out of those or other Ancient manuscripts of those parts which may be usefull or at léast grateful to posterity. We recommend his request to you and intreat your pardon for his and our boldness therein.[359]

Accordingly, Henry Hills, a printer, was recommended by the Company in March 1674, after ascertaining his qualifications,[360] to be sent out as a printer 'at Bombay or Surat' carrying with him 'a printing press with letters and other necessaries and a convenient quantity of paper . . . the cost of all not to exceed 150 pounds'.[361] It was also decided that the cost of the 'whole affair of printing be placed to the account of Bemjee Parrack'.[362] Eventually, Hills came to India late in 1675.[362a] What happened subsquently is described in two letters of the Sūrat factors to the Company as follows:

> (a) *22 January, 1676/77 (Surat)*:
> The printing designe doth not yett meet with the success as expected by Bimgee Parracke, who hath taken great pains & bin at no meane charges in contriving ways to cast the banian characters after our

English manner; but this printer being wholy Ignorant therein, & not knowing anything more than his own trade is noe way's usefull to this designe; wherefore Bimgee hath desired he may be employed in the Companys service, and indeed he hath bin ever since he came; & he will be very usefull to your Island Bombay, whither we intend to send him to stay there till your further order. We have seen some paper printed in the bania character by the persons employed by Bimgee which looke very well and legible & shows the work is feasible. But the charge and tediousness of these people, for want of better experience, doth much discourage, if your honourable would please to send out a founder or caster of letters, at Bimgees charge, he would esteem it a great favour . . . wee can reasonably demand of him for the printers charge hitherto. [363]

(b) *21st January, 1677/78 (Surat)*:
Here is little occasion for Henry Hills Printer, for Bimgee pretends he did desire one, but not an English Press which in short time will decay & requires him to teach these people his art of Printing, which he refuseth to doe, being against his oath and order of that society, so that his printing is layd aside for the present, & he made steward of your house in Surat for these 10 [?] months or more, that he might doe somewhat for his wages of 50£ per annum, wherein wee cannot commend his good husbandry or carefullness. Although your Honours hath paid his wages (as your servant by contract for 3 years) yet Bimgee stands charged for it in accompt a part, untill you please to advise therein, his time will bee expired in May next; the founder which President Aungier at his desire wrote out also for, wee conceive will signifie to as little purpose, for one of them cannot act well without the other, and wee are rather inclynable to beleive the Bannians will be more apt to print their owne superstition in their owne character then anything of Christianity, and theire children should be taught our bookes whereby to learne it . . .[364]

It would be unfair to lay the entire blame for this failure on Bhīmjī. The fault lay in the choice of the technician: it should not have been ordinarily expected of a printer to prepare the founts; it was the job of a type-caster. Type-cutting and type-founding had grown into a highly specialized art in Europe. Even by the middle of the sixteenth century, the Roman types in England were imported from other countries where they were manufactured by expert workers. Later, when the English produced types locally with the help of hired or purchased matrices, the result proved to be very poor. It was only after

1665 that serious attempts were made in England to improve the quality of their types.[365] Not surprisingly, therefore, Henry Hills, a printer, was obviously a wrong man to do the job. That Bhīmjī's project fell through because Hills refused 'to teach the Indians how to print' is not admissible: it was indeed a desperate implicit admission on his part of his ignorance of type-casting. That is why the English President at Sūrat wrote to the Company that Bhīmjī was unsuccessful because of the inexperience of the printer in this sort of work, and appreciated Bhīmjī's request that a type-caster be sent out at his expense.[366]

But it is doubtful whether a type-caster from England could easily have performed what Bhīmjī required of him. The latter wanted types of 'Braminy' character—most probably the Devanagari script. We know that the Polyglots published on the Continent were printed in numerous languages; in England, the London Polyglot [1654–7) was printed in nine scripts including Persian.[367] In 1665, Nicholas Nicholls prepared a specimen-sheet of types cast in England which, besides Roman, included Greek, Hebrew, Syriac, Samaritan, Ethiopic and Arabic.[368] The Oxford University Press which began its work in 1478 was presented by Dr Fell in the 1660s 'a noble collection of letter' including Armenian, Coptic, Rumic, Turkish, Persic and most significantly, Malayalam,[369] which were acquired from the Continent. But not a single type-specimen of the Devanagari script was ever attempted in Europe during our period.

At any rate, there is no evidence that a type-founder was sent from England to assist Bhīmjī. On the other hand, it is clear that the 'persons employed' by Bhīmjī were Indians who contributed their mite. And it seems that at that crucial moment Bhīmjī lost heart and abandoned the project mid-way.

It is, however, a pity that Bhīmjī did not think of using Arabic or Persian types which he could have procured from Europe. One might equally wonder why Persian-speaking scholars at the royal courts, or under the patronage of nobles, failed to pay attention to such types? The first book printed in Arabic type appeared in 1514 in Italy.[370] In 1528, Arabic characters cut in wood were printed in England.[371] The Vatican published the Bible in Arabic in 1591.[372] And Leyden in the seventeenth century led the rest of Europe in producing oriental founts,

especially Arabic.[373] Could not Indian scholars have procured these founts from Europe? Even a certain Mulla, 'Abdus Sattār, an eminent scholar, whom Akbar had commissioned to study the language of the 'Frangīs' and who is reported to have studied under the guidance of Father Xavier and later collaborated with him in translating his Latin work into Persian (subsequently printed in Europe and distributed in India), did not show any interest in this new technology.[374]

A European, in 1689, noticed the absence of printing among Indians, and sought to explain it as follows: 'Neither have they endeavour'd to transcribe our Art of Printing; that would diminish the Repute and Livelihood of their Scrivans, who maintain numerous families by the pen.'[375] As a matter of fact, Ovington was trying to transfer the experience in his country, that is, England, to India. In the words of Chappell: 'In the cradle years of printing, opposition came chiefly from organized calligraphers and illuminators whose livelihood was threatened.'[376]

The political consciousness of Indian scribes was not sufficiently developed to trigger organized resistance to the introduction of printing. At any rate, there is nothing in contemporary records to warrant Ovington's opinion simply because printing was never seriously thought of by the *aristocratic patrons* of Indian scribes. That a really serious effort was made by an Indian from the *mercantile class* should convince us that there was no element of inherent resistance amongst Indians—Bhīmjī failed for reasons beyond his control.

MECHANICAL CLOCKS

The history of horology unfolds a variety of devices adopted by mankind in different countries. Among them, the gnomons, sun-dials, clepsydras, sand-glasses, mechanical clocks and watches stand out as the most significant contrivances for time-reckoning with varying degrees of accuracy.

In India, during the sixteenth and seventeenth centuries, clepsydras appear to have been the main device for measuring time, at any rate, in urban centres.[377] It is reported that water-clocks (the sinking-bowl variety) continued to be used in India,

even in the villages, down to the early decades of the twentieth century.[378]

Broadly speaking, there have been two basic types of clepsydras—the 'outflow' and 'inflow' types. The former involved the determination of time taken by a vessel of specific size to empty itself; the latter by noticing the time a vessel with no perforation below took to fill.[379] But descriptions of Indian water-clocks indicate a type different from the above two: in fact an 'inverse variant' of the outflow type, details of which will be provided.

The source of the Indian word, *gharīyāl*, is derived from the gong that was struck with a mallet to announce the time indicated by the sinking-bowl. The Persian term for the latter was *tās*; *tās gharīyāl* denoted the whole mechanism, that is, bowl and gong.[380] It has been suggested that the Indian word *gharī* referred to both, i.e. the bowl and gong.[381]

The water-clock is first mentioned in India in the Persian sources in 'Afīf's *Tārikh-i Feroze Shāhī* which relates the installation of a *tās gharīyāl* by Sultān Feroze Shāh at Ferozābād during the second half of the fourteenth century. It is unfortunate that while 'Afīf offers kudos to the Sultān by pointing out the seven 'other-worldly' benefits to be derived from this contrivance, he neglects to give us any detail of its construction, especially of the type of bowls used.[381a] Another source, *Sīrat-i Feroze Shāhī*, does not mention this device, but speaks of the installation of an astronomical astrolabe by the same Sultān at the same place.[382] Perhaps both the devices were used for purposes of comparison. In any case, a clear description of an Indian sinking-bowl is given in the *Bāburnāma*, and later in the *Ā'īn-i Akbarī*. The information gathered from these two sources, and supplemented with more details from a large number of other sources, provides us with the following picture:[383] an empty narrow-mouthed copper or brass goblet twelve 'fingers' (*angusht*) high, with a capacity of 1½ pints, with a very small round orifice drilled through the bottom,[384] was put in a buoyant or floating state in a great bowl or basin of clear water kept at a place undisturbed by wind, etc. The time taken by the perforated goblet to fill, and sink, served as a unit of time-reckoning. Two attendants—'one sleepeth while the other waketh and

tendeth'—announced the time by striking the hanging gong with a wooden mallet in accordance with some definite rules. The sequence was then repeated.

We may here point out two things: first, the sinking-bowl variety was in use in India from ancient times, although as Fleet has shown, it yields in antiquity to the 'outflow' type.[385] That the latter continued to be used during the seventeenth century is attested to by two European travellers, Terry[386] and Fryer.[387] Nevertheless, there is overwhelming evidence in favour of the inverse variant, the 'outflow' type. Perhaps the pure 'outflow' clock might have been used occasionally as witnessed by the two travellers cited above. Secondly, the manner in which Bābur describes the sinking-bowl indicates it did not exist in the culture-area from which he came.[388]

It is conceivable that the Portuguese brought the European mechanical clock to South India during the sixteenth century,[389] but it is not possible to say whether clocks were introduced into North India at the same time. Hājī Habībullāh, who was sent by Emperor Akbar to Goa (1575) to bring European novelties to the Court,[390] might possibly have brought such clocks from there, though our Persian sources do not mention it. At any rate, European clocks were available in North India during the seventeenth century on a modest scale.

It seems that even before 1613 the English factors at Surat received clocks from England. In 1613, however, the English company 'resolved' not to send any clocks for three reasons: (a) 'because they are quicklie out of frame and none can mend them but clockmakers'; (b) the risk of their being damaged during the voyage; and (c) because it was uncertain how the people in India 'doe accompt their daies'.[391] But this resolve did not last long. In 1616, Sir Robert Shirley presented a standing striking clock of silver to Emperor Jahāngīr which had in it other 'pretty inventions'.[392] Soon after, Sir Thomas Roe gave a clock along with two other 'trifles' to him.[393] Otto Kurz says that the first watches to reach the Mughal court came from Persia when in 1616 Shāh 'Abbās sent an embassy to Jahāngīr with many gifts, among them 'five clocks' (not of Persian workmanship),[394] but Jahāngīr's memoirs do not allude to gifts of clocks and watches either from Europe or Persia.[395]

Yet another more significant episode has gone undocumented

in the Persian sources: Richard Steel, an English adventurer, came to India with a painter (Hatfield) and a clockmaker with a view to acquiring patronage from the Emperor, and thus to earn some 'profits'. But eventually he failed in getting Jahāngīr interested in clockmaking.[396]

The English factors at Bālāsore asked the Company in 1650 to send four or five good 'substantial house-clocks' to be given as presents to the governors and princes.[397] In 1666, Tavernier gave a 'watch having a case of enamelled gold' to the 10-year-old son of Shā'ista Khān.[398] He also presented costly watches to a high Mughal official, and to a eunuch of Princess Jahān Ārā' Begum.[399]

We are told that the steeple of Jesuits church at Āgra, built during Jahāngīr's reign, had a public clock-face with a bell whose 'sound was heard in every part of the city'.[400] The steeple was later demolished by Shāh Jahān in the 1630s. Again, in 1667, the English factors at Bombay asked for a striking clock from England 'that may be heard over all the garrison'.[401] Apart from such occasions, individual European travellers carried with them watches and clocks[402] which must have been seen by a large number of people who came into contact with them, especially members of the mercantile class.

Notwithstanding the exposure of a substantial cross-section of Indians to the mechanical clock for such a long time, there is no evidence to indicate its acceptance among any social group of Indian society for general use. This lack of interest in clocks was noticed by Ovington in 1689, and he attempted to explain it:

> The Indians have not yet attempted an Imitation of our clock-work in watches; and may be it is, because they seldom continue their just Motions for any long time, by reason of the Dust that flies continually in the Air which is apt to clog and stop the wheels.[403]

This explanation is as unsatisfying as that given by Jean Chardin in reference to Persia (1683) when he said that the 'Persians had neither clocks nor watches' because of the humidity of the air which made all iron rust.[404]

We may consider this problem from another angle. In 1615, the English factors asked for a clock fitted with some *rare devices* 'to strike after the Moors' fashion'.[405] This provides us with at least one clue, that is, the principles of time-measurement in

India were different from those in Europe. In the latter, the system of twelve equal double-hours prevailed,[406] while in India it was based on a system of 4 quarters (*pahr*) in the day from sunrise to sunset, and another 4 quarters in the night from sunset to sunrise. Further, each quarter or *pahr* was divided into *gharīs* (of 24 minutes each). But owing to the eccentricity of the earth's orbit and its tilt at the axis, the relation between the number of the *gharīs* and *pahr* never worked out correctly, varying from 6 to 9 *gharīs* at different places, and finally it conformed to the basic formula of 60 *gharīs* in a day and a night.[407] Thus, while the Indian system had 60 'hours' of 24 minutes to the full day, the European consisted of 24 hours of 60 minutes. Obviously, then, the European clock would not have served any purpose for Indians unless they adopted the European system of 12 equal double-hours.

Could not the European clocks have been modified to bring them in line with the Indian way of measuring time? That they could is clearly indicated by the evidence cited above; if it was not so, the request of the English factors to send a clock to 'strike after the Moors' fashion' would be utterly meaningless. We are not in a position to say whether such modified clocks actually came to India. In Japan, where 'unequal' hours existed, variable-hour clocks fitted with many curious devices were used for a long time, while the Chinese, on the basis of their 12 equal double-hours, took easily to European clocks.[408]

Indeed, it appears that the use of the water-clock by Indians had such traditional force that even Europeans in India were compelled to adopt it. Bowrey observed:

> Most Mahometans &c. of accompt in Hindustan use them at theire doors in the street where they have generally a porch built . . . The English and Dutch have them at the gates of all theire inland factories in this Kingdome [i.e. Bengal] or others in Hondustan, verifieinge the old Proverbe, *Cum fueris Romae*, &c.[409]

Thus, one public clock at Āgra and the other at Bombay were not sufficient to lure Indians into seriously accepting its use. In fact they saw Europeans themselves taking to the Indian clepsydra at their official residences!

Yet another minor point could be brought forward, that is, the high cost of a watch or clock. The two watches that Taver-

nier gave as presents to a Mughal noble and a eunuch of Princess Jahān Ārā' cost 480 and 174 rupees respectively. It is true that these watches were expensive because of their richly decorated cases; nevertheless, they do show that watches, and especially the house-clocks, must have cost a lot.[410] In fact, we have not been so far able to unearth any evidence of the purchase of European clocks by Indians during the seventeenth century, although clocks continued to be brought to India in large numbers, mostly as gifts.[411]

Finally, it must be admitted that Indians most probably could not appreciate the significance and implications of the two most essential features of an ordinary mechanical clock, that is, the weight-drive and escapement, especially the latter, which has been regarded as the 'soul of the wheel-clock', and its invention welcomed as the 'most extra-ordinary of all the inventions of man'.[412] Even the modified form of the clock to suit the Indian method of ascertaining time might have been of great help in understanding its mechanism. But that too failed to strike the fancy of Indians in contrast to the Japanese.

GLASS TECHNOLOGY

Glass is a complex artificial industrial substance, its basic ingredients during our period being silica and any alkaline flux like potash, soda or limestone and, sometimes, oxides of lead. Glass-making might have started with an attempt at imitating rock-crystal or quartz, which are themselves pure silica whose fusion was not attainable in those times since it required very high temperature.[413]

The use of glass in the context of world history has been traced back to 2500–2000 B.C., originating in Mesopotamia and Egypt.[414] The earlier opinion that it was not *known* in India even in Chalcolithic times has been questioned, and hence the earliest *use* of glass in India[415] has been set somewhere during the first millennium B.C.

The presence of an object in a society may reveal its possible use but does not necessarily also imply a knowledge of its technology. Secondly, in this particular case, the term *kācha* (now used for glass) in ancient Sanskrit literature was 'a general term for a variety of matter used for ornamental purposes.'[416]

There were other meanings too: crystal, an eye disease, alkaline salt, wax, etc.[417] Again, one should also be careful about the difference between crystal, quartz, obsidian glass, glaze, faience and true glass.[418] In some cases, the zeal for glorifying ancient Indian culture takes unwarranted forms. As an example, we may cite the following grandiose declaration:

> Hence, glass manufacturing had reached a high pitch of technological skill and perfection in Ancient India and became a *beacon light* [emphasis ours] to emulate such an advancement in the other countries of the world.[419]

That glass was not scarce in India has been ably verified by Dikshit in his excellent monograph. It is fair to infer, then, that long familiarity with imported glassware must have led to indigenous manufacture, though it is not possible to lay our finger on the exact period. But, as Dikshit admits, Indian glass objects 'did not range or go beyond the manufacture of tit-bits like beads and bangles'.[420] While these may attest to a knowledge of how glass could be manipulated for small articles, do they conclusively show a knowledge of how the material, i.e. glass itself, could be made? One or two sites have been excavated in Uttar Pradesh (*c.* 3rd century B.C. to 3rd century A.D.) where glass fragments and lumps of unworked glass have been found.[421] Do these lumps represent the broken and melted pieces of imported glassware which were being worked upon by local artisans?[422]

However that may be, it cannot be denied that Indian artisans did learn glass technology (both the material and its fabrication), but excellence could never have reached a level that could become a 'beacon light' for other countries.[423] At the same time, it must be added that an overwhelming proportion of glassware in use in India was imported, especially articles other than beads and bangles. This is borne out by the fact that as compared to the 'affluent period' for the spread of glassware in India (from the Mauryas to the end of the second century A.D.), the Gupta period has been considered the 'dark period' in the history of Indian glass.[424] This astonishing gap during the 'golden period' of Indian history cannot be explained except by pointing out that there was some great disruption of foreign trade with countries which traditionally supplied glassware to

India. The revival of the glass trade surfaces with the period coinciding with the arrival of Muslims in India.[425] It was during this period that pharmaceutical phials, jars and vessels started coming to India from the Islamic countries in abundance.[426] Among the presents sent to the Chinese emperor by the Chola king in the eleventh century A.D., glass items are recorded to have been included which seem to have come to India from southern Arabia.[427] Rightly, then, Dikshit concedes that studies on Indian glass should take into account 'contacts with countries outside India which were responsible for the shaping of the industry at different periods in the history of India'.[428]

Abul Fazl takes note of glass-production in the Mughal provinces of Bihār, Awadh and Āgra, but he fails to say what objects were actually turned out.[429] Again, the reference to the manufacture of *shīsha-i zar afshān* (gilt-glass?) in Bihār is so vague that we cannot infer anything: other Persian sources do not mention it or spell out the details, nor is it noticed by any foreign traveller. One wonders whether Abul Fazl is not referring to mica in Bihār whose qualities faithfully respond to his term, that is, *shīsha-i zar afshān*?

During the sixteenth century, it appears that a variety of glass objects were imported largely from Europe: imports from southern Arabia received an initial setback, probably as a result of the Portuguese blockade.[430] It may be reasonably presumed that the Portuguese introduced European glassware to South India; in the north, it seems to have been brought during the second half of the sixteenth century.[431] It is really during the seventeenth century that one meets with considerable documentation of European glassware imported into India which included looking-glasses, window-panes, spectacles, telescopes, burning and 'multiplying' glasses, sand- or hour-glasses, etc.

Mirrors

Metallic mirrors were used and made in ancient India as in other contemporary civilizations.[432] It has been pointed out that no mirrors were discovered during excavations at Mohenjodaro until 1928.[433] The three specimens found there are all made of bronze and were apparently cast. They are slightly oval, with vertical handles to hold them. Besides, they have recessed, plane

faces which were originally polished for reflection.[434] That these mirrors may have been manufactured in the Indus culture-area, and were not imported articles, is proved by the fact that while the mirrors of foreign cultures in India's vicinity had both their faces polished, those of the Indus culture had only the recessed faces so treated. During the Gupta period, an Ajanta painting depicts a lady holding a mirror, slightly oval in shape, with a handle at the back which is not clearly visible.[435] A similar mirror has been reported in a carving from Mathura.[436] A clear depiction in stone can be seen in a temple at Khajuraho where a lady has been shown looking into a round mirror held in her hand by a loop-handle behind it.[437] What is striking, however, is the absence of vertical handles in the post-Mohenjodaro specimens referred to above. Perhaps the handles of the Mohenjodaro mirrors were in line with those of mirrors from civilizations in her proximity, for example, Sumer. On the other hand, the inland regions, namely, Ajanta, Mathura and Khajuraho, developed another form. In this case, it may be suggested that they were not cast like those from Mohenjodaro. These mirrors may have been of bronze, but those of copper also are reported to have been used before the Gupta period.[438]

Later, an early Mughal painting (*c.* 1590) provides some vague details about the fabrication of round mirrors; it also reveals the restoration of vertical handles, similar to the Mohenjodaro ones.[439] In fact, Mughal paintings never depict mirrors with loop-handles during the seventeenth century. While the use of bronze and copper might have continued, we find evidence for steel also (see below).

In Europe, up to the Medieval period, metallic mirrors were in general use. From the fourteenth century, glass mirrors—actually an extension of the knowledge of making sheet and plate glass—started to be used along with the metallic ones. The significant breakthrough came with the application of 'tin-foil' in about 1500, which was quickly adopted by the Venetians, and soon the looking-glasses of Venice flooded the European market, pushing aside metallic mirrors.[440]

European looking-glasses as a novelty were acquired by the Indian élite either through purchase or gift from Europeans. As early as 1608, William Finch saw a few large Venetian mirrors placed one above the other on the walls of Emperor Jahāngīr's

court at Lahore.[441] An Italian in 1615 was reported to have gone to Jahāngīr's court at Ajmer with looking-glasses where he sold some wares to Āsaf Khān, a great Mughal noble.[442] Considering that this article would have a large market in India, a certain Robert Young, who was taught 'the skill of foylinge looking-glasses' at the English Company's expense, was sent to Sūrat in 1614 in order to instruct four or five English factors in this art.[443] And thus, in expectation, a large number of glass-mirrors seem to have been brought to Sūrat. But due to the slow clearance at Sūrat in 1619, twenty-five glasses were sent to the Red Sea for sale.[444] Two years later, however, Muqarrab Khān purchased a great looking-glass at a very high price, that is, 300 rupees. Another—a 'double' one—was sold for 1,250 rupees.[445] Later, in 1625, the English factors were optimistic about the sale of this item,[446] but in 1652, they wrote that these would be useful largely for presents since little sale could be expected.[447] In 1668, a faint hope of its sale in Bengal was raised, but it did not materialize.[448] Earlier, the Dutch trade at Āgra, among other things, consisted of 'large and small looking-glasses', but later in the 1660s the trade had shrunk.[449] It does not appear that looking-glasses were substantial articles of trade by this time. Since the prices were high, especially of the larger ones, they were vendible among the upper strata only. Even the élite, in many instances, acquired this item in gift.[450] Other social groups in India continued using metallic mirrors which were more durable: their only inconvenience was that they had to be 'rubbed and brightened every day, else it rusteth . . .'[451] Even in Bombay, under the immediate influence of English settlements, we are told in 1689 that the Indian barber carried a round steel mirror with a short handle for his customers to look in.[452]

The situation, however, changed by the end of the seventeenth century. In 1702, the Sūrat factors wrote: '. . . there being several looking-glasses the frame of which broke and unglued & looking-glasses Broke for want of good package probably may produce something if sold to the Barbers . . .'[453]

Again, in the same year, we get information on the sale of this item to Indian merchants.[454] The following year, a number of varieties of glassware, including looking-glasses, were offered for sale by the English factors[455] when Rustamjī, a Parsi merchant, purchased a large glass-mirror (44″ × 30″) for 296

rupees.[456] Perhaps such a high price was an exception because the evidence since 1683 indicates that prices of this item were within the means of the middle-class. For example, the cost of a looking-glass (28″ × 25″) given in gift to the Emperor's *dīwān* at Patna in 1683 was thirty rupees.[457] In the same year, the cost of another given to *mīr bahr* at Patna was two rupees.[458] Yet another given to one of the subordinates of the Nawab's *dīwān* cost three rupees.[459] A fourth one, given to the *amīn* of the Patna mint's *dārogha*, was valued at four rupees.[460] It is unfortunate that the sizes of these mirrors have not been mentioned; but these examples do show the low cost of this article. The low cost was due to the steadily rising production in England after 1615, especially in the wake of the invention of the 'coal process' which helped greatly in the development of glassmaking in that country 'by settling it on a sound economic basis'.[461]

The foregoing examples only hint at the increasing *use* of the European looking-glass by the Indians, especially among the middle-class; they do not indicate its manufacture in India during the seventeenth century either by Indians or Europeans.

It is puzzling that, in spite of the widespread use of European looking-glasses by Indians, we have not been able to trace a single pictorial depiction of this in Indian paintings during the seventeenth century. While the familiar round metallic mirror with a handle occurs frequently throughout the period,[462] it is only in the paintings of the following century that we discover the European rectangular looking-glasses.[463] The sketch of a barber in *Tashrīh-al Aqwām* (1825) reveals that by the beginning of the nineteenth century Indian barbers had set aside their traditional metallic mirrors in preference to European looking-glasses.[464] Perhaps manufacture of the latter had commenced in India by this time, making this article widely available at a low price. In fact, an account of glass manufacturing in a Persian glossary confirms that by the 1740s Indians had learnt the use of quicksilver in making looking-glasses.[464a]

Spectacles

Yuan Chwang (seventh century A.D.) mentions the manufacture of 'crystal lenses' in India,[465] but there is no evidence either for the use of spectacles made of these lenses, or for the manufacture of glass lenses in ancient India. Gode has shown

that it is only in the second decade of the sixteenth century that we discover the use of spectacles (made of glass lenses) in India: the Portuguese presented a pair of (European) spectacles to an old scholar in the Vijayanagar Empire who used it for reading Sanskrit manuscripts.[466] Rudolfus, a member of the first Jesuit mission at Akbar's court in 1580, is reported to have used spectacles.[467] In 1616, the English factors at Sūrat sent a large stock of glassware, including spectacles, for sale at the Mughal court in Ajmer.[468] Āsaf Khān, in 1625, asked for some English spectacles which were duly forwarded to him,[469] though his portraits never depict him wearing them. Other nobles too do not appear to have used this article.[470] Careri, who saw Aurangzeb in 1695 at a very old age, noted with admiration that the Emperor could endorse petitions 'with his own hands without spectacles'.[471] On the other hand, Pietro della Valle saw an old man in 1623 at Cambay using spectacles.[472] Mughal paintings have yielded a few compositions in which scribes and painters have been depicted wearing them.[473] In 1683, the English factors at Patna gave spectacles to the following in gift:[474]

a.	*dārogha* of the Patna custom-house	2 pairs
b.	Two subordinates of the above	do
c.	*munshī* of the *nawāb* of Patna & others	6 pairs
d.	*amīn*	1 pair
e.	Emperor's *dīwān*	do
f.	a subordinate of *dīwān*	do
g.	*mutasaddī* of *dīwān*	3 pairs

In two cases (above), the price of one pair[475] has been recorded as $1\frac{3}{4}$ rupees, and of the other, one rupee and twelve pice.[476] Such low prices are corroborated when we are told that the Patna English factory in 1684 had a stock of 26 pairs of spectacles whose total value was thirteen rupees and twelve pice.[477] Perhaps low prices might have encouraged the scribes, accountants, painters and others to purchase spectacles when unable to procure them through gift.

That markets for spectacles came into existence during the first two decades of the eighteenth century, or perhaps even earlier, is fairly clearly indicated in letters written by Saiyid 'Abdul Jalīl to his son, Mīr Saiyid Muhammad, during this period.[478] The former had purchased one pair at Bhakkar (Sind)

which was mislaid by his attendants when he came to Delhi in 1717. In his letter he says that he was looking for spectacles in Delhi where this article was freely available but had not yet been successful in locating a pair which suited his eyesight. He adds that he was despatching two pairs for his son which had been purchased in Delhi. The significant passage in this letter is an inquiry about a pair of European spectacles with a wooden frame left behind in his home and which suited his eyesight best. He suspected his son had lent it to someone, and therefore asked him to get it back if possible. What is of interest is that this particular pair is referred to as being of European make, though it is not clear whether he had purchased it, or got it in gift from some European. On the other hand, the one pair that he bought at Bhakkar, and the two pairs purchased in Delhi for his son, are not referred to as of European make. It indicates not only the existence of markets for spectacles, but probably also their manufacture by Indians at this time, though on a modest scale. But it cannot be determined whether Indians had learnt the fabrication of glass for making lenses, or they worked upon glass imported from Europe. Although the evidence for the manufacture of spectacles with glass lenses on the eve of the eighteenth century is not very strong, there are indications of positive response from the letters discussed above: after all, the manufacture of crystal lenses was not alien to Indians. In fact one may perhaps also argue that these Indian spectacles were made of crystal lenses.

Sand-glass

We have previously referred to sand-glasses brought from Europe. This article seems to have been readily accepted and used for astronomical purposes. Some Mughal paintings, while depicting a birth scene in a harem, do not fail to show astrologers casting the horoscope with a sand-glass[479] by their side, along with other equipment. Again, Manucci refers to its use in the Mughal army.[480] Earlier, John Marshall (1668–72) had observed: 'In some places, as at Patna, they have glasses with sand in them, made like our houre-glasses in England, which are exact gurry [*gharī*]'.[481]

We have mentioned earlier that the *gharī* was of twenty-four minutes duration. We know of one hour, half-hour, and even

half-a-minute glasses in Europe,[482] but not those of twenty-four minutes. It is clear that these glasses were made in India during the second half of the seventeenth century. In fact, their manufacture required no great skill.[483]

Hubble-bubbles

Tobacco and the *huqqa* were introduced in the court of Akbar early in the seventeenth century, and thenceforth, smoking became extremely widespread in India. While the low-income group used the *gurgurī* (the coconut-bowl *huqqa*), the élite used glass and jade *huqqa* bowls. Some of the latter of the late seventeenth century have been listed by Ashton.[484] The suggestion that these (and also the wide-necked spittoons) could have been the work of some Persian craftsmen attracted to the Mughal court[485] is a mere conjecture since no evidence is offered. John Marshall (1670s) speaks of the manufacture of 'neat hubble-bubbles' at Bhāgalpūr[485a] in Bihār, although he leaves it uncertain whether the bowls were made of glass or the coconut. An Armenian merchant reports that he purchased fourteen *qaliān* (hubble-bubbles) at Patna in 1693; once again we are not told about the material used.[485b] A Persian glossary compiled in 1748 notes that 'Azīmābād (Patna) produced the finest glassware including (glass) hubble-bubbles (*qaliān*) which were taken by merchants to other towns.[485c] Perhaps glass *huqqa* bowls were manufactured at Bhāgalpūr and Patna on a *small* scale during the second half of the seventeenth century. But it cannot be determined whether the technique of making glass bowls was learnt under Persian or European influence.

At any rate, it can be safely stated for the seventeenth century that glass *huqqa* bowls remained *largely* items of trade, both from Europe and Persia, the latter make coming mostly through the European agency.[486] Indians procured hubble-bubbles either in gift or by purchase. For example, two merchants, 'Abdul Ghafoor and Sohrābjī, were given two each[487] by the English factors in 1702. Another merchant, Āghā 'Peeree' in Sūrat (1697), had arranged with the English factors to buy twenty-two hubble-bubbles.[488] That the sale of this article had become a profitable business is shown by the action of the governor of Sūrat in 1697 when he forced the English factors to sell him twenty-two glass hubble-bubbles meant for Āghā

'Peeree', which the former wanted to resell in the town 'to his profit'. In 1703, a number of hubble-bubbles were put on sale along with other glassware, and purchased by many Indian merchants and brokers (at Sūrat).[489]

Apart from looking-glasses, spectacles, sand-glasses, and *huqqa* bowls, Europeans brought drinking-glasses, multiplying glasses, burning glasses, prospective glasses (telescopes), and triangular glasses. Again, other glassware included ewers, rose-water bottles, basins, water-bottles, plates, mugs, 'beatlle' boxes, etc.[490] The first set was entirely of European origin, except the drinking glasses; while the second set was a mixed—European and Persian—one. The English merchants at Sūrat regularly imported these articles both as gifts and for sale.[491] Even broken glasses were purchased by Indian merchants from Europeans because they were sold at a low price.[492] It can only be suggested that perhaps some of the glasses for purely domestic use might have been fabricated indigenously; the same could not be said for multiplying, burning, prospective or triangular glasses.

MINING

Contemporary records provide us, by and large, with detailed accounts of mining, but only about two sectors, salt and diamond. We will leave out the former because European travellers do not offer any relevant comment on it by way of comparison with their own countries, and also because the horizontal excavation of salt-rock in India did not pose any substantial mining problem.[493]

Diamond Mining

In 1622, Methwold, while offering his comments on diamond mining in Golconda, pointed out two features that distinguished the mining-processes in India from those in Europe.[494] First, mining in India was not 'carried underground and supported with timber', but dug right down in 'square large pits' without giving a thought to whether the earth thus dug up would be really profitable or not. In Europe mining followed the 'veines' which eliminated unnecessary digging. Secondly, he noted that Indians did not employ 'pullies and such like devices' for bailing

out water and bringing up the earth; instead, a large number of people, sitting one above the other, 'hand up from one of another' water or earth. There is no evidence that these two features gave place to European techniques notwithstanding that numerous Europeans were interested in the methods of diamond trade. A possibility of change could have been expected had Europeans, like Indian merchants, taken diamond-bearing land on lease from Indian rulers and prospected under their personal supervision. At the same time, Europeans do not appear ever to have discussed these techniques with Indians.

Incidentally, it has been suspected that there was no deep mining in India, and the diamond mines never extended below the water table.[495] But Methwold presents a different picture. Commenting on the lack of mechanical means to clear away water, he notes: '. . . and from hence proceedeth the use of so many people, seeing that, besides the earth, the place where overnight they wrought dry is next morning a fathome deepe under water'.[496]

He also says that the digging went to '10 or 11 fathome deepe'. Again, when Careri says that mining at Kullur extended to a depth of '12 or 14 spans', he also adds,' below which there is no hopes of any Diamonds'.[497] On the other hand, mining at the top of a flat hill was only 3 feet deep, but in the valleys it was much deeper—10 to 12 feet.[498] Naturally, then, the depth of mining depended on the availability of the material sought for.

This is an opportune moment to shift from diamond-mining to diamond-cutting and polishing. It may sound strange to hear Fryer saying that diamonds cut by the Indians fell short of the 'Fringies in Fancy', and that is why they were sold mostly in India; to Europe the diamonds were exported uncut and cut 'to more advantage'.[499] Tavernier, the European expert in precious stones and diamonds, firmly opines: 'The Indians are unable to give the stones so lively a polish as we give them in Europe.'[500]

It was for this reason that European jewellers were accorded a warm reception in India. As early as 1584, William Leeds, an English gem-expert, accepted service under Akbar who 'gave him an house and five slaves, an horse, and every day six S.S. [shillings] in money'.[501] Jahāngīr mentions a European jeweller

(*hakkāk*) under his employment on whom he bestowed the title *hunarmand*.[502] When Mīr Jumla gave Aurangzeb a large uncut diamond, it was returned to him so that he could have it cut by an expert, for which purpose a Venetian lapidary was sent to him.[503]

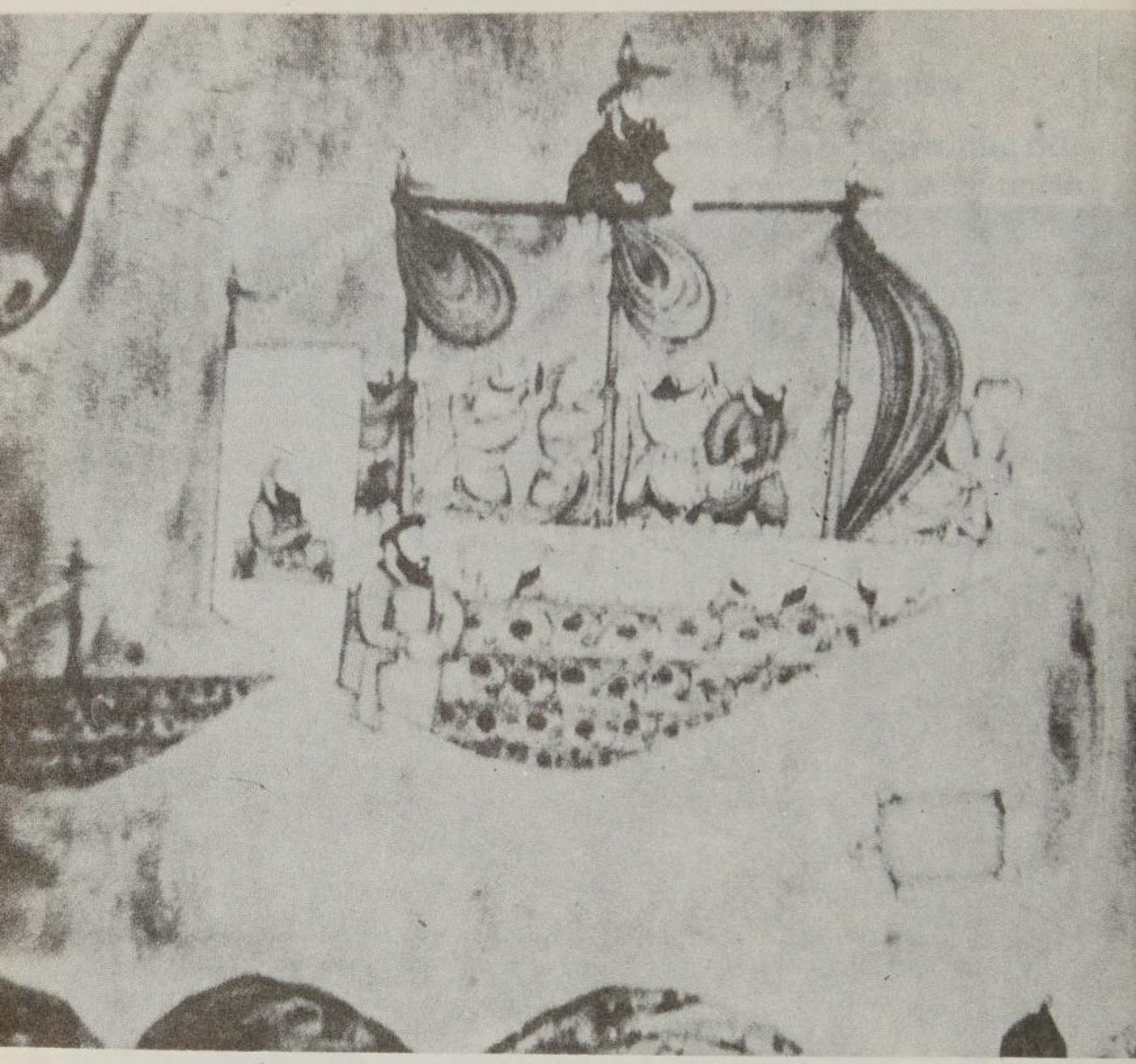
Among the accounts of Tavernier,[504] Fryer[505] and Thévenot,[506] only the first has attempted to find out the reasons for the inferior quality of the diamonds cut and polished in India. Explaining the inability of Indians to impart a polish comparable to diamonds polished in Europe, Tavernier says:

> . . . and this, I believe is due to the fact that their wheel does not run so smoothly as ours. For, being made of steel, in order to grind it on the emery, of which it has need every twenty four hours, it has to be taken off the tree, and it cannot be replaced so as to run as evenly as it should so. If they possessed the iron wheel as we do, for which one does not require emery but the file, it not being necessary to remove it from the tree in order to file it, they could give the stones a better polish than they do . . . it is desirable that it should be done every twelve hours if the workman is not lazy. . . .[507]

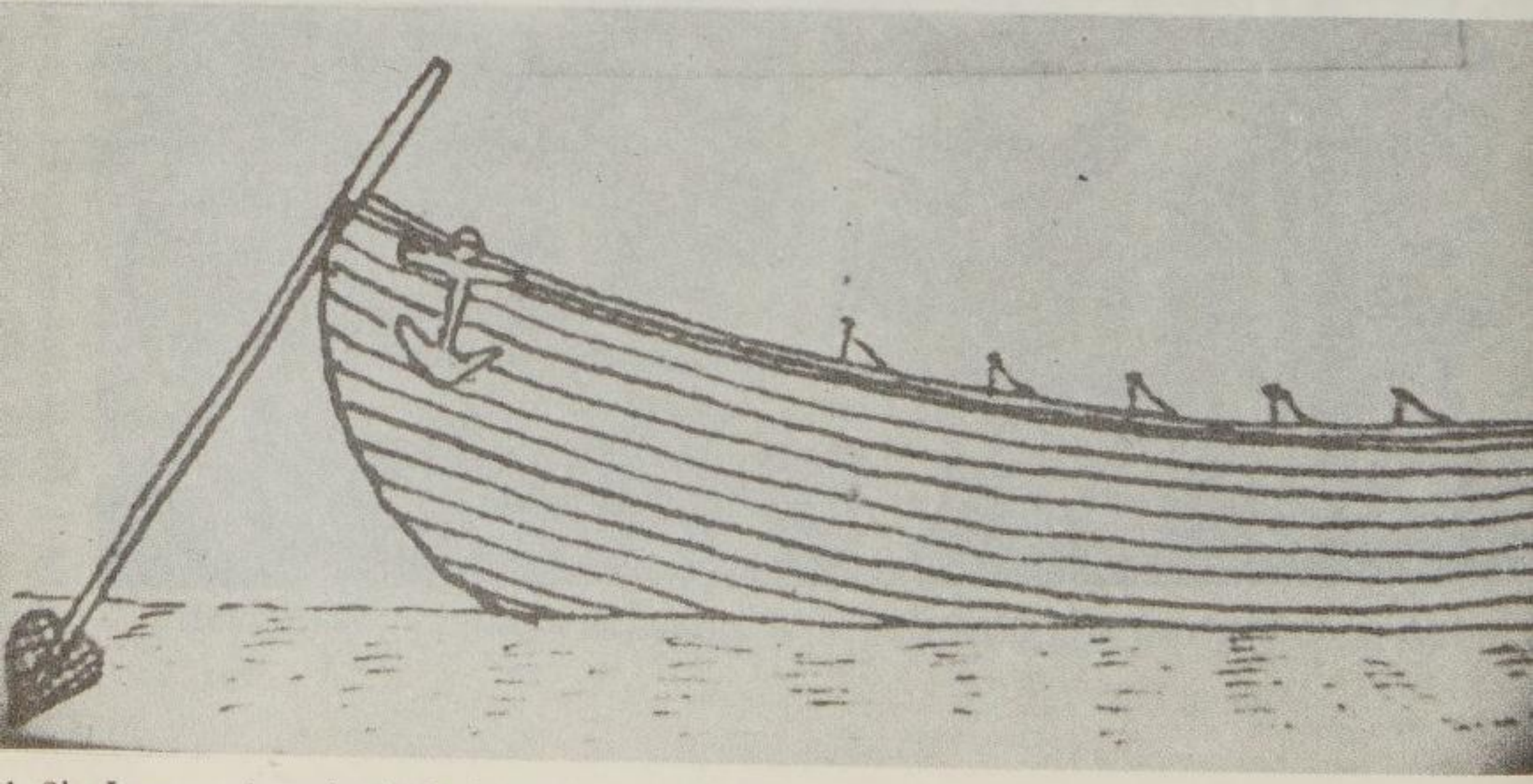
Besides, Tavernier was of the opinion that the process of 'weighting' the stone which could cause flaws was not current in Europe; but he keenly notes that this process did not produce flaws when practised in India because the wooden wheel, which caused the steel one to revolve, did not run as fast as theirs in Europe because its motion was slowed down, first, by incessantly anointing it with oil and sprinkling it with powder; and secondly, the wooden wheel was not more than three feet in diameter while the European one was bigger. On the other hand, he appreciates the skill of Indians in cutting the 'knots' in a stone, which, as he says, 'our diamond-cutters in Europe would experience great difficulty in doing, and as a general rule would be unwilling to undertake it'.[508] Again, in another context, we are told that the Indian miners strike blows at the diamond-bearing rocks with a heavy iron crowbar which sometimes fracture the diamonds; but this rough handling was duly compensated by cleaving the stone along the fracture-line in a way better than that in Europe.[509]

European lapidaries in India, especially those who were employed by the rulers or nobles, must have used their own devices for diamond-cutting and polishing. But evidence is not

P1. 1 Planks joined with iron, detail. Note the rabetting method. (*Dārābnāma*, BM.Or. 4615, f. 76b, upper half of composition.)

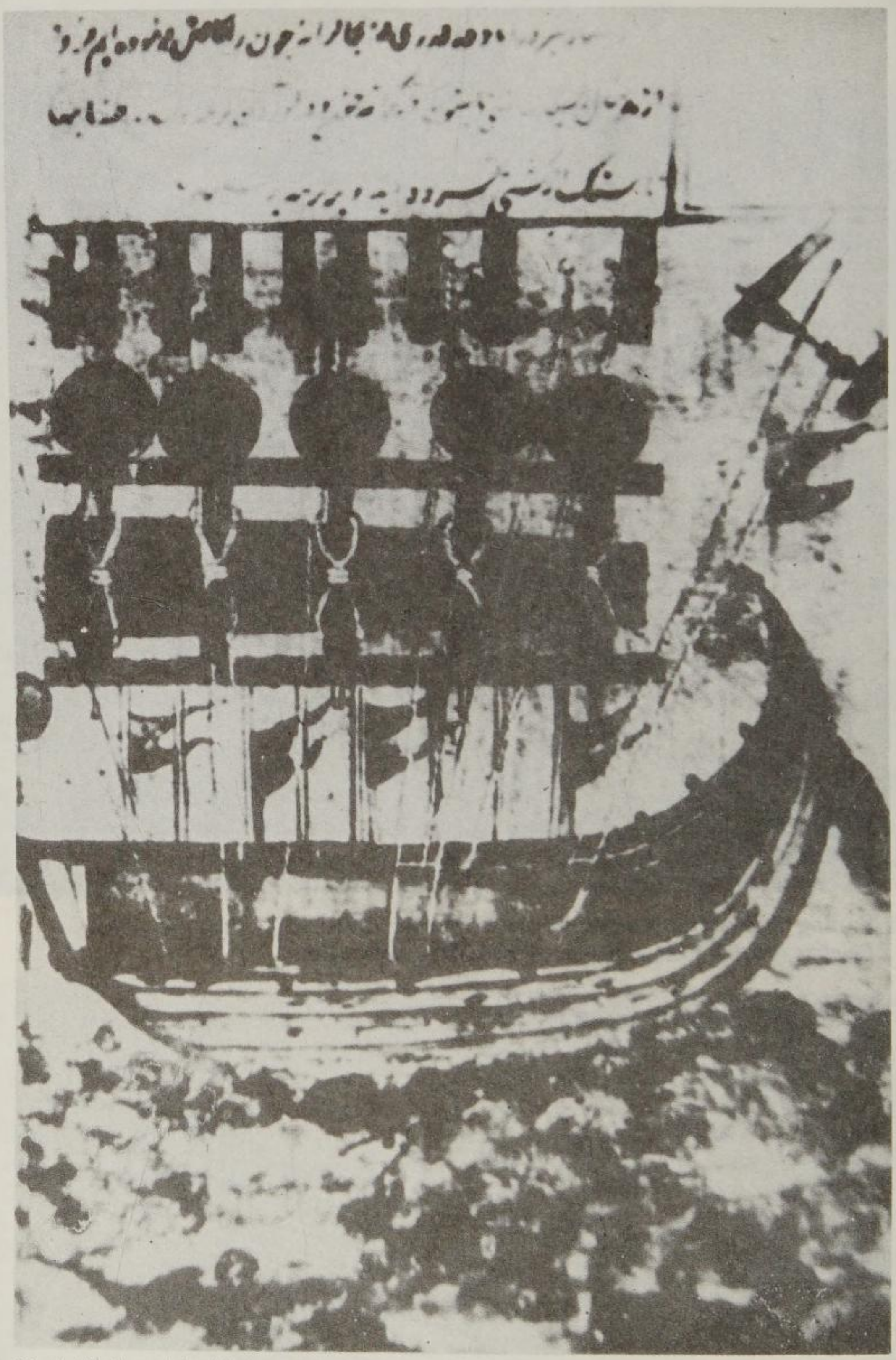


l. 2a Stone anchor. Note the small dark object in the water attached to a rope.
(*Anīs-ul hujjāj*, P1. 2)

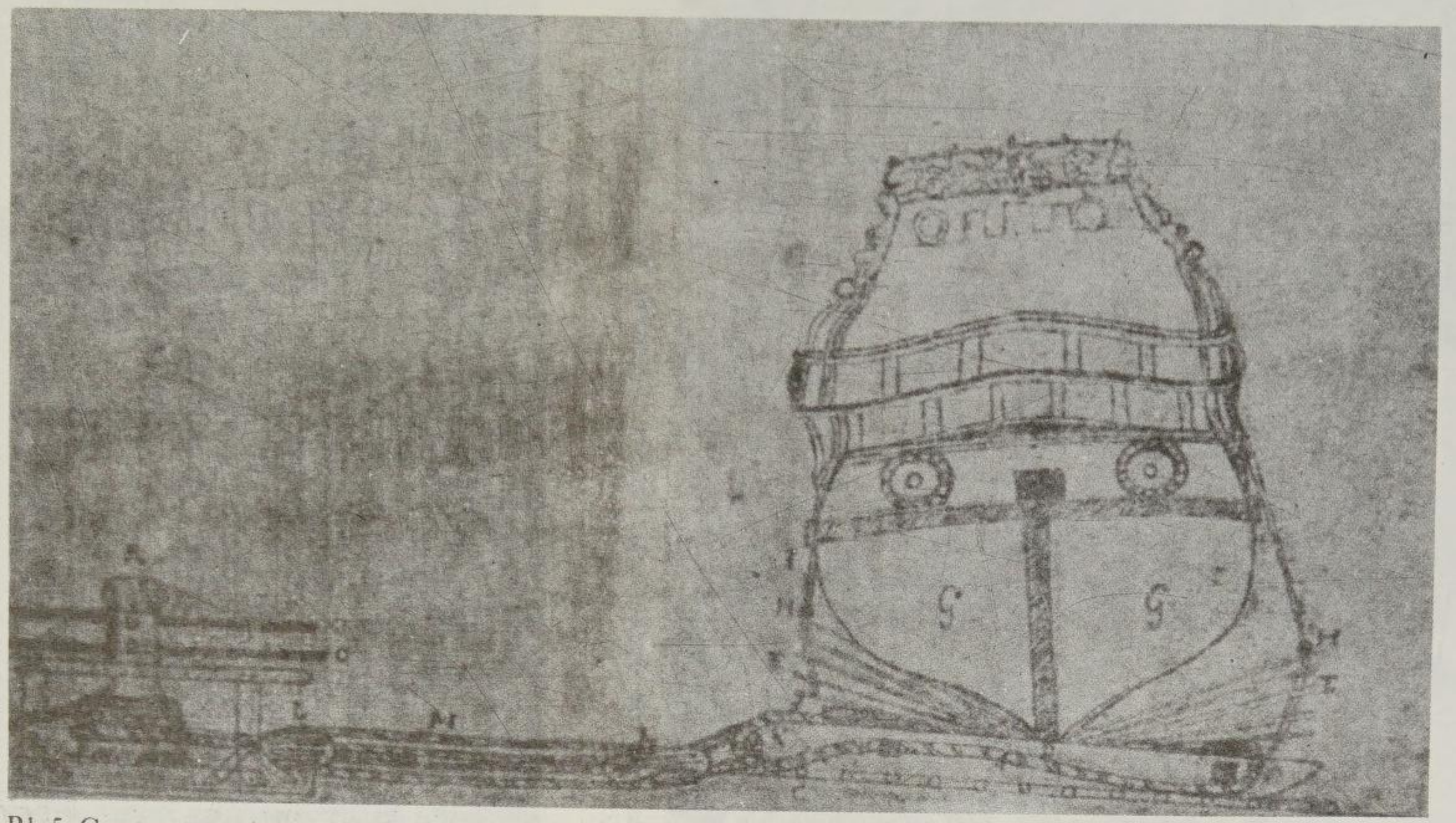


l. 2b Iron anchor. Look for it on the left side of the boat, near the oar.
(Bowrey, P1. xiii, fig. 3.)

. 3 Bailing out water on Indian ships with bucket, detail. (M. Goedhuis, *Indian Painting*, Pl. 91, from a dispersed folio of the *Baburnāma*.



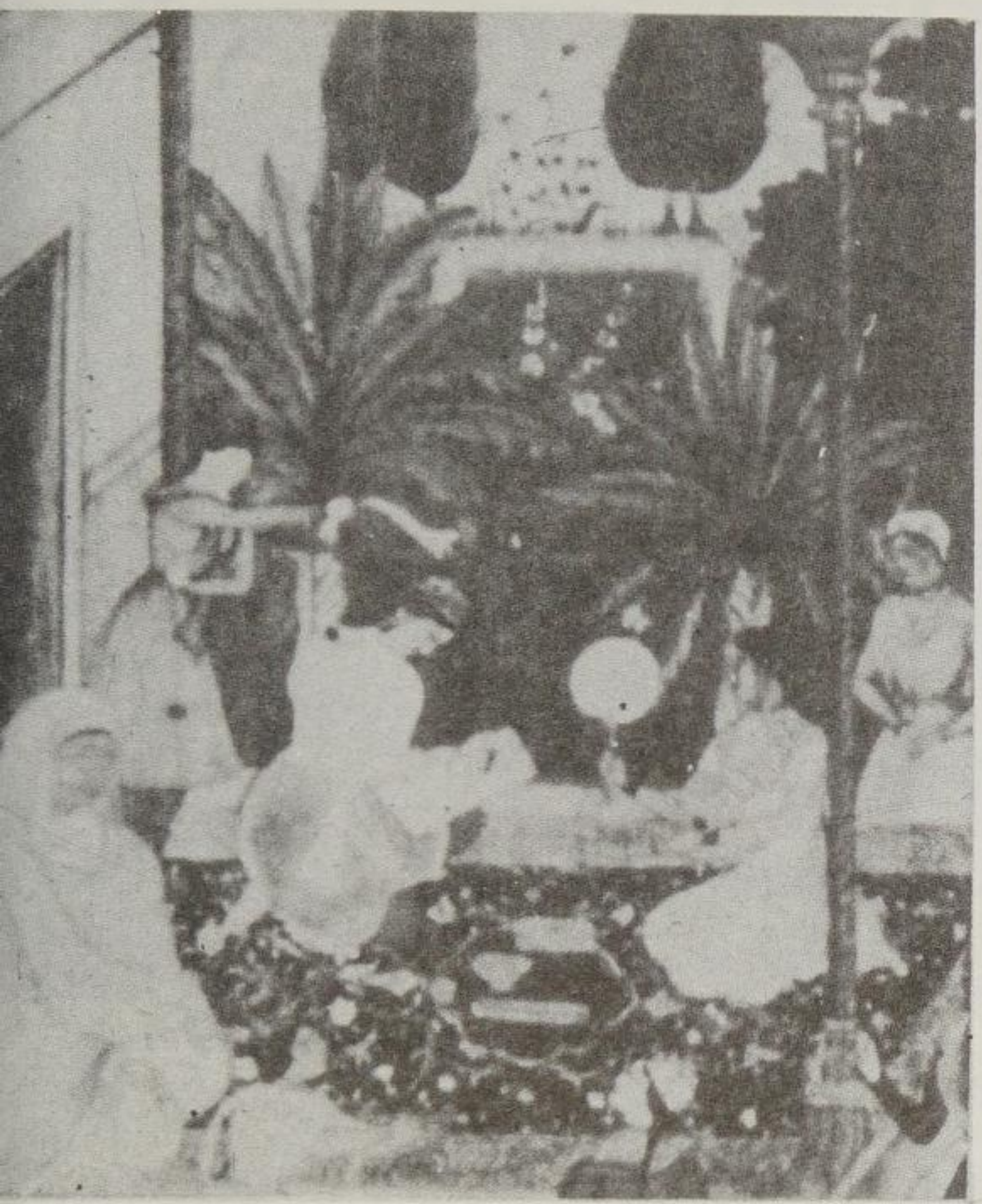
P1. 4 Pulleys (*charkhīs*) used for hauling the Ashokan pillar. The dark round objects are the wheels of the cart on which the pillars are placed. The wheeled-cart carrying the pillar is being hauled onto the boat with the aid of pulleys. (*Sīrat-i-Feroze Shāhī*, f. 98b.)



Pl. 5 Capstan to careen a ship. The capstan is at the left. (Bowrey, Pl. viii, fig. 3.)

P1. 6a *Rathas* with yoke on the necks of horses. (*Razmnāma*, BM Or. 12076, f. 35b.)

P1. 6b Use of fork. (Arn
and Wilkinson, i
P1. 78(b).)



Pl. 7a Metallic mirror (India detail. The lady paint a self-portrait while her attendant faces he holding the mirror. (*Khamsa*, BM Or.1220 f. 206a.)

Pl. 7b Making Indian metallic mirrors, detail. (M. Daumas, *History of Technology and Invention*, Pl. 46. The original painting is in the Indian Museum, Calcutta.)

Pl. 8a Rectangular looking-glass, detail, Rajasthan *c.* 1750. (L. Hajek, *Miniatures from the East*, Pl. 23, 'Vilaval ragini'.)

Pl. 8b Rectangular looking-glas
While the barber is at wo
his client looks at himself
in the glass. (J. Skinner,
Tashrīh-al Aqwām, BM Ad
27255, f. 211b, 1825.)

9 Spectacles, detail. (Ivanova, P1. 23, 'Poetry Recital', upper half.)

P1. 10 Sand-glass, detail. Notice the small sand-glass in the foreground beside the book. (*Akbarnāma*, BM Or. 12988, f. 34b, 'Birth of Timur'.)

Pl. 11 'Adam', line-by-line copy. (Arnold and Wilkinson, iii, p. 77. See M. C. Beach, 'The Gulshan Album and its European Sources', *Bulletin of the Museum of Fine Arts*, Boston, No. 332, 1965.)

P1. 12 'Christ Stilling the Storm on the Sea of Galilee', copy. (BM (OA) 1920-9-17-032.)

Pl. 13 'La Parabole de la Juraye', European engraving..(V & A, D 132-1885 (25).)

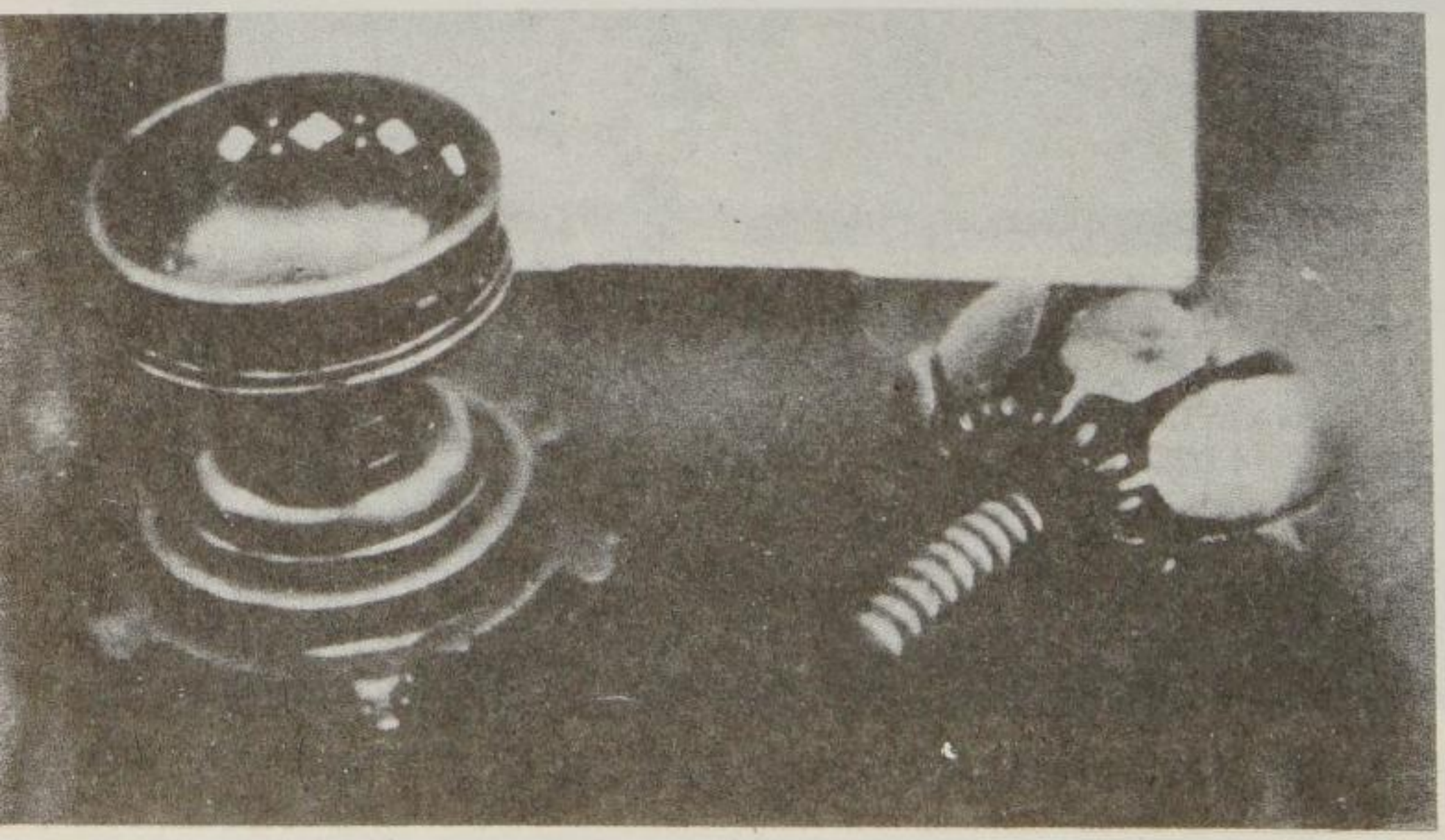
Pl. 14 'Descent from the Cross', copy. (V & A, IS 133(79)-1964.)

P1. 15 'Arithmetica', detail, line-by-line copy by Manohar. (Ivanova, P1. 20, upper portion, central figure.)

P1. 16 'A Wooded Landscape', copy, genre painting from a Dutch original. (BM (OA) 1942-1-24-03.)

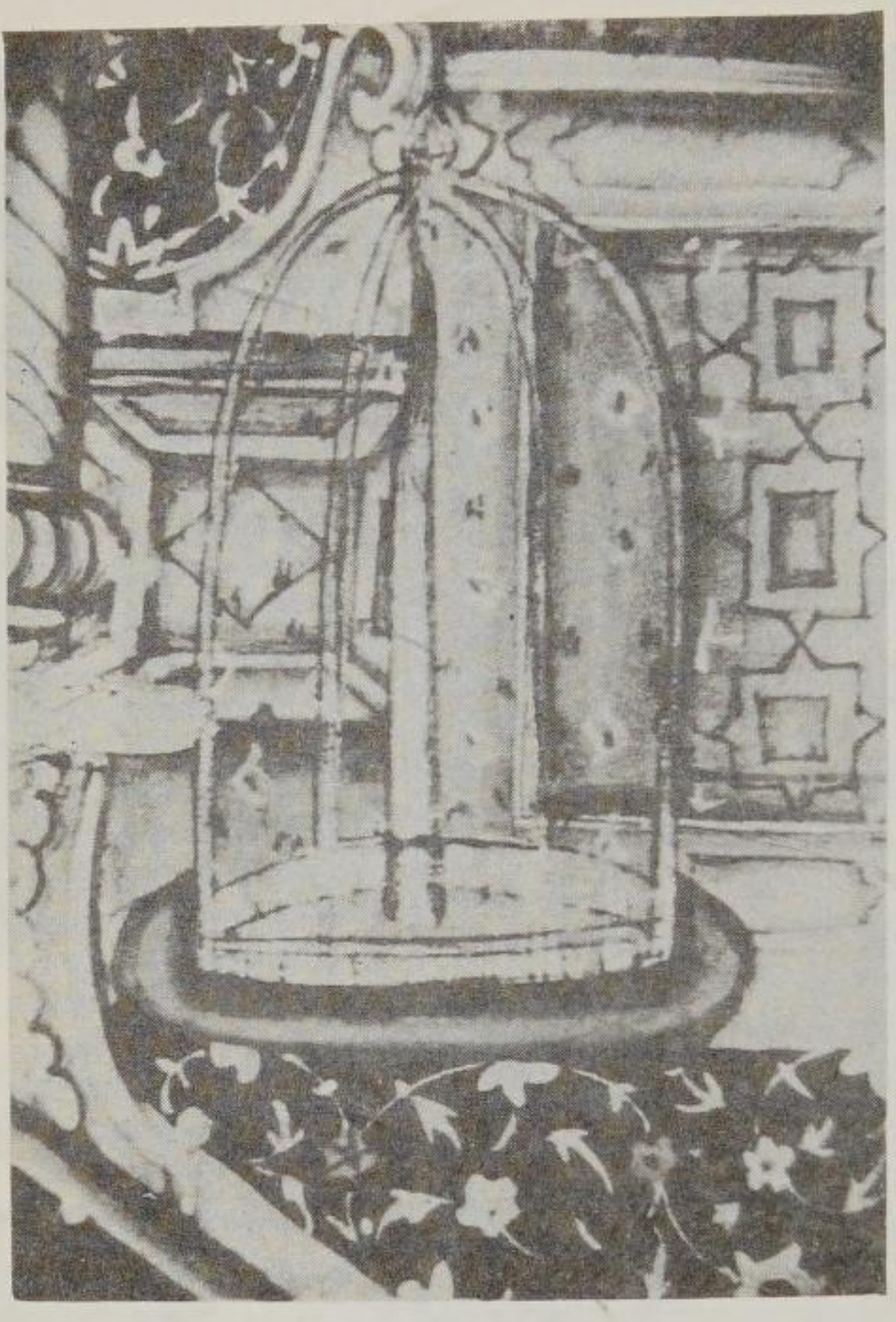
Pl. 17 'Woman in European Dress Feeding Pet Birds', Mewar, *c.* 1720. (BM (OA) 1956-7-14-028.)

Pl. 18a 'Plato, Charming Anima with Music', detail. The musical instrument is a European organ. (*Khamse* BM Or. 12208, f. 298a.)

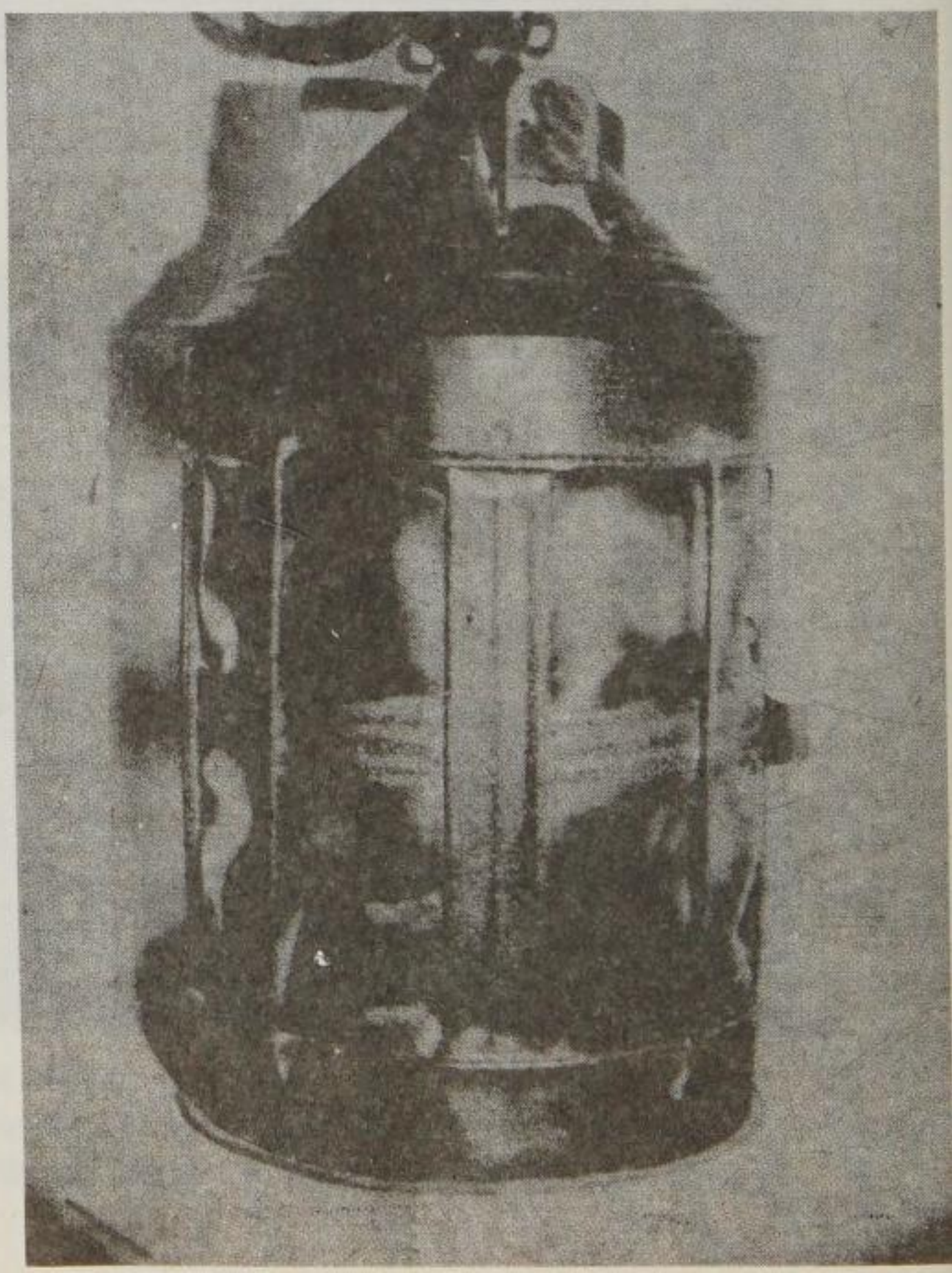


Pl. 18b Screw (Indian) 'forming part of the brass "petal" votive lamp (left side), made by wrapping a wire round a metal rod and securing it with a solder. This screw has a left-hand thread'. (Science Museum, London, Inventory No. 1936-235.)

P1. 19 Tobacco smoking, Rajasthan, *c.* 1800. The aristocrat smokes on horseback, his attendant on foot carries the *huqqa*'. (BM (OA) 1956-7-14-036.)



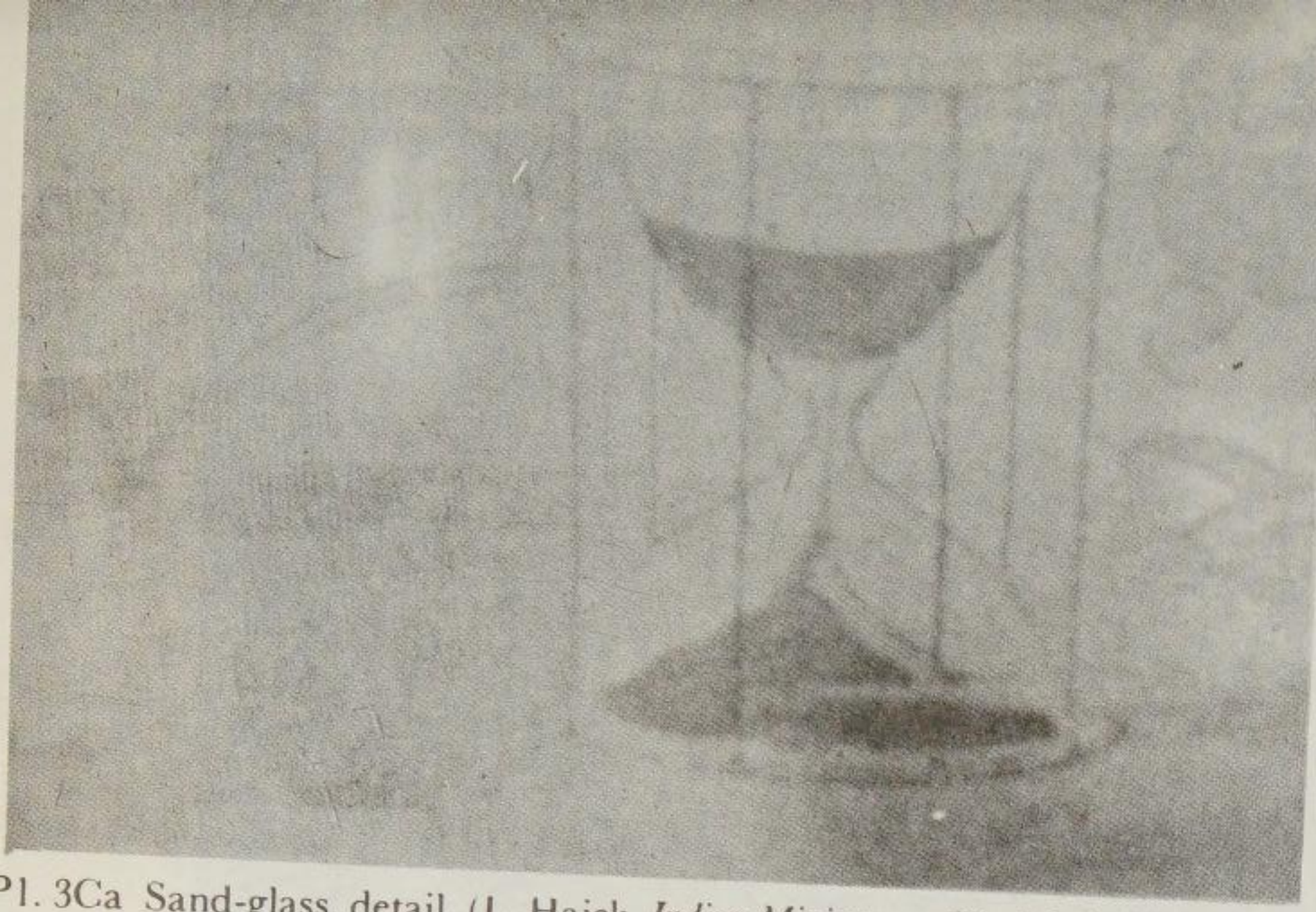
P1. 20a Lantern (Indian), detail. Note the transparent candle-shade. (*Akbarnāma*, BM Or.12988, f. 128b.)



P1. 20b Horn-lantern (European). (Museum of the History of Science, Oxford.)

P1. 1C Planks joined by iron, detail. Note the rabetting method. (*Akbarnāma*, V & A, 4/117.)

P1. 2C Horse-drawn carriage, detail. Note the absence of the yoke which suggests use of an alternative type of harness, details of which are unfortunately not clear. (Arnold and Wilkinson, iii, frontispiece, 'A Rustic Scene', *c.* 1625.)



Pl. 3Ca Sand-glass, detail. (L. Hajek, *Indian Miniatures of the Mughal School*, Pl. 18, 'Astrologer with Sand-glass, etc'.)

Pl. 3Cb Gem cutting/polishing. The use of the bow drill on a ruby. (L. Hajek, *Indian Miniatures of the Mughal School*, Pl. 8.)

P1. 4C Globe, detail. (R. Ettinghausen, *Paintings of Sultans and Emperors of India*, P1. 12.)

forthcoming to identify Indian response in this area. Most probably Indian experts continued with their traditional tools and methods: for the cutting of sapphires and diamonds, Thévenot observes: 'They cut Saphirs with a Bow of wire; whilst one workman handles the Bow, another poures continually upon the stone very liquid solution of the powder of white Emrod [emery stone] made in water; and so they easily compass their work.'[510]

The use of the 'bow of wire' is corroborated by a rare Mughal painting, although it does not depict Thévenot's 'other' workman who poured the liquid solution of emery upon the stone.[511]

Coal

It is well known that India for centuries had two main sources of fuel, wood and cow-dung. In Europe, coal had been discovered as a new source of heating, and it was used for a few selected purposes during the sixteenth and seventeenth centuries, though largely confined to England and northern France.[512]

The first mention of 'sea-coals' in India was in 1612–14, when these were brought by the English to Sūrat and appeared such a novelty that they were carried 'for a wonder to the Mogol', that is, Jahāngīr.[513] There is no record of Indian response to this new fuel beyond this, either in Sūrat or at the Mughal court. Sea-coal might have continued to come to India, since in 1644 'collow' (coal-dust) and 'coales' were reported aboard an English ship destined for India.[514] In the early 1660s, the English factors at Madras asked for 'sea-cole' from England[515] which was duly provided.[516] But the quantity sent from England must have been quite small, while it is certain that the English at Sūrat did not use coal. Ovington wrote in 1689:

> Wood is the only combustible matter in Suratt, which is commonly made use of in the Kitchen, either by Indian or European, for boiling and roasting their victuals. Some of the more poor Natives make fires of dried cow-dung.[517]

However, at Bombay, the English appear to have started using coal for minor industrial purposes. In 1670, the factors complained in a letter to the Company that the coal sent from

England proved so bad that they had to burn charcoal in the forges. The cost of charcoal, they wrote, was very high, and its deficient supply at times interrupted the working of the smith's forge.[518]

The dearness of charcoal at Bombay might have been a local phenomenon. There is no evidence of 'timber famine' in any other part of the Indian sub-continent, except perhaps Sind where we are told that 'In or about Tuttha groweth no timber for aedifices, nor have they any but what is thus brought them'.[519] The extensive tracts of forest land in India perhaps provide a partial answer to the question why the Indians did not take to coal-mining when even surface deposits could have been found in some coal-bearing regions.[520] The use of coal in England spread simply because wood had become scarce both for domestic heating and industrial uses. Extension of agriculture into woodlands and waste on the one hand, and the cutting down of woods by the indebted landlords on the other, created a shortage which led to the search for a new source of fuel in England.[521] There is no parallel to this 'fuel crisis' in India.

The use of coal at Bombay by the English was a late and isolated case to which the Indians were hardly exposed. Europeans did not use coal in a way that confirmed its utility in the eyes of Indians, nor did they take to coal mining in India. In fact, Europeans started taking interest in coal mining only from 1774, and it took a long time before it was put on a modestly sound footing which coincided with the advent of steamboats in India around 1829.[522]

Saltpetre Refining

We may be allowed here to refer to saltpetre refining, though it is not directly related to mining. The English factors at Madras observed in 1652:

> . . . the general use here of refineing is in great earthen panns; but so tedious and troublesome for ridding of business, caused by often breakinge of these potts or panns, that to our certaine knowledge above 200 of them fell too peeces in the cureing of 600 bags landed here last year . . .[523]

That's why the Dutch are reported to have imported copper pans from Holland and set up a refinery in 1640–1 at Pipli in

Orissa.[524] The Dutch had also established a 'depot' for refining at a village, Chapra, about fourteen 'leagues' from Patna. In the second half of the seventeenth century, they decided to refine it themselves, and with this in view imported metallic boilers from Holland. But this project provoked protest from the residents of the village engaged in the refining: they stopped supplying whey to the Dutch which was an essential material for bleaching saltpetre. The Indian refiners protested so much not against the import of metallic pans: they resented the Dutch intention of depriving them of the profits from refining done by them with earthen pots.[525] No such protest against the Dutch is heard of at Pipli. Again, we do not know of any opposition from the Indian refiners when the English, who used to send the 'Patna saltpetre' home unrefined owing to the want of copper pans, proposed to set up metallic boilers.[526] At any rate, it cannot be ascertained whether Indians took to metallic pans in imitation of the Europeans. Perhaps Indian refiners may have been discouraged by the comparatively higher cost of metallic boilers.

TEXTILE TECHNOLOGY

We find Europeans, during the seventeenth century, often complaining of Indian fabrics in terms of their lack of availability in dimensions required and used in Europe. They therefore fervently tried to persuade Indian weavers to alter their looms suitably to weave cloth in accordance with their orders, but did not always succeed. It must be pointed out emphatically that the occasional unwillingness of Indian artisans to introduce changes in the looms was not a result of any tradition-bound aversion to innovation. That alterations could have been made by artisans to meet the demand of European buyers is attested to by the evidence at hand.[527] However, our interest lies in the fact that Europeans did not bring their own techniques in the textile craft to India, at any rate during the first half of the seventeenth century. In fact, Europeans did not possess any superior technology in this field during this period,[528] except perhaps in one sector. In 1668, a suggestion was submitted to the English Company to send silk dyers, throwsters and weavers to Qāsimbāzār in Bengal.[529] Of dyeing it was thought that while some Indian dyes were better than comparable European ones,

some others were entirely unknown to Indians.[530] It was discovered that Indian 'fancy' was upon 'mixt colours, and that they have not skill to dye good Blacks greenes and watchetts'.[531]

Following the decision of 1668, a large number of 'silk' artisans were sent from England to Bengal.[532] Bowrey wrote:

> The English Company keepeth many tradesmen att worke here by order of the Company, as dyers, weavers, throwsters, &c. beinge English men sent on purpose for the orderinge theire silke after the English custome, and for dyinge a good black, a colour the Natives cold never dye well.[533]

What interests us is the Company's conviction that no great headway could be made without the native artisans being trained by their English counterparts.[534] It is unfortunate we do not possess further information on the transmission of technique in the sector of silk manufacture from European to Indian craftsmen in Bengal during this period.

CHAPTER III

PAINTING, ARCHITECTURE AND MUSIC

Traditionally, any reference to painting in medieval India, especially during the seventeenth century, invariably brings to mind first the Mughal school of art, the regional schools taking the second place. Broadly, the Mughal school of painting has been viewed from two perspectives: first, it has been considered as a kind of 'provincial variety' of the Persian school for which the term 'Indo-Persian' has been used; secondly, it has been looked upon as a 'hybrid blend' of East and West.[1] Concerning the first, Martin is right when he says:

> The term Indo-Persian has in my opinion been incorrectly applied to Indian miniature painting. It is precisely the same as if one called the French art of the 16th century Franco-Italian. It was only in the very beginning, during the reign of Akbar, A.D. 1556, that Persian influence was apparent, and very soon an individual style was developed so different from the Persian influence that there can be no question of any mistake between the two.[2]

That the Mughal school was eclectic in its formative period in relation to its acceptance of Persian elements should not surprise us since its patrons had initially come from the Persian culture-area. And thus, the Persian style, as Binyon says, passed into Indian painting when Humāyūn brought with him two painters to India from Persia.[3] But in its later phases, especially during the seventeenth century, the Mughal school appears to have been influenced more by European art than Persian.[4] Wilkinson observes that the 'European share in Mughal painting . . . was actually greater and more permament than that of Persia, an influence not always fully recognized'.[5] It is worth mentioning here that Mughal painting was never essentially *hieratic*; therefore, there could be no reluctance on the part of artists or their patrons to accept innovations.

DEGREE AND NATURE OF CONTACT

Taking into account the number and variety of subjects, it could fairly be said that, in comparison to any contemporary country in the Islamic culture-area, the Mughal period witnessed the 'greatest extension of the scope of painting'. Actually, with Akbar began the process of abandoning the traditional lukewarm attitude which arose out of a dubious ban on drawing the likeness of animate objects. He combined his own preferences with 'a fresh interpretation of religion' in order to give it 'a rational shape'.[6] He is said to have remarked:

> There are many that hate painting; but such men I dislike. It appears to me as if a painter had quite peculiar means of recognizing God; for a painter in sketching anything that has life, and in devising its limbs, one after the other, must come to feel that he cannot bestow individuality upon his work, and is thus forced to think of God, the giver of life, and will thus increase his knowledge.[7]

Also, Akbar's interest in the exotic[8] was perhaps one of the weightiest factors in the development of Mughal painting, especially in bringing it face to face with European art. Even before the three official Jesuit missions between 1580 and 1605 at his court, Akbar had come into contact with Europeans in 1573, and again in 1578.[9] Perhaps Akbar had acquired some specimens of European art during this period;[10] however, the reception accorded to the three Jesuit missions provided ample opportunities to the court artists to familiarize themselves with European art.

As has been mentioned earlier, the first Jesuit mission from Goa, led by Rudolph, Aquaviva and Monserrate in 1580, presented to Akbar at Fathpūr Sīkrī a copy of the seven volumes —out of eight—of Plantin's Polyglot Bible written in five languages and illustrated with engravings of religious subjects, largely by Italianized Flemish artists, most probably belonging to the school of Quentin Matsys (1466–1531).[11] These volumes remained in the Imperial Library for fifteen years till 1595 when they were returned to the third Jesuit Mission.[12] Besides these volumes, Akbar possessed other Bibles and concordances, works of St. Thomas Aquinas, Ignatius, of scholastic writers, etc.[13] In 1581, Monserrate showed Akbar many illustrated sacred books when the latter was marching towards Kābul. Apart from the

books, the Emperor was presented with many independent paintings on several occasions by the Jesuits.[14]

Jahāngīr's self-confessed interest in painting is well known; even as a prince he displayed great enthusiasm in acquiring paintings from Europe.[15] The list of items desired as gifts for Jahāngīr that Muqarrab Khān gave to the English also contained 'pictures in cloth'.[16] Thomas Best in 1613 wrote home asking for an annual consignment of a 'good store of pictures, for thease are presents fitt for the great Magoll . . .'[17] Sir Thomas Roe recommended large pictures in cloth with the 'frames in peaces' as presents.[18] He wrote: 'pictures of all sortes, if good, in constant request'.[19] Indeed, Jahāngīr's desire for European pictures had become 'almost embarrassing'—it was estimated by the English authorities that in one year (1613?), out of £695 spent by the English East India Company on articles as presents in India, £255 were for pictures alone.[20]

Coming to Shāh Jahān, we find him, as a prince, greatly interested in acquiring European paintings when he was the governor of Gujarāt before his rebellion. Once, in 1621, he is reported to have been furious when he learnt that the English had stealthily taken out a painting for presentation to his father without first showing it to him.[21] If the examples of paintings under his patronage are any guide, it could fairly be said that perhaps his interest in European art did not languish in his later years.[22] But during Aurangzeb's reign the fire kindled by Akbar appears, to a considerable extent, to have lost its glow.

Leaving the sovereigns, we come to the nobles and high officials. During Akbar's reign, 'Azīz Koka, whom the Jesuits thought to be a 'bigoted Moor', desired on two occasions to have a copy of the Madonna del Popolo[23] and that of Christ presented to him.[23a] In 1614, the English presented two paintings to Muqarrab Khān at Sūrat.[24] Later, Roe offered him a series of thirteen paintings representing Christ and the Apostles.[25] Roe also gave to Jamāluddīn Hasan a book with forty-eight pages of pictures, 'beeing the whole historie of our saviour Christ'.[26] Āsaf Khān and Mirza Beg were also presented with paintings by Roe.[27] At a lower level, a painting of Moses was given to Khwāja Nizām, primarily a merchant, and the governor of Sūrat in 1614.[28] Little purpose would be served by listing all such nobles and officials who came into contact with

European paintings. These examples, however, suffice to indicate the trend of opportunities available to the élite for acquainting themselves with exotic art.

For other sections of society (excepting the painters to whom we will come presently), there was perhaps only one way which could have brought them into contact with European art—and that was the exhibition of religious pictures in the Jesuit chapels and churches thrown open to the public. We are told that the Jesuit fathers in 1580 had set up a chapel within the palace enclosure at Fathpūr Sīkrī where they had placed over the altar a copy of the Madonna of St. Luke which drew a large crowd, both of Hindus and Muslims.[29] Again, in 1602, they exhibited at Āgra a copy of the Madonna del Popolo which was admired by hundreds of persons from every social group—from the 'poor women' residing near the Church to the daughters and wives of the grandees—even the 'Mullas' did not lag behind.[30] The Jesuit account says:

> By counting those who entered the Church on a particular day, it was shown that the daily attendance exceeded ten thousand persons. The Fathers had so much to do to maintain order in so great a concourse of people that they were unable to spare even a quarter of an hour for their repast, which they were obliged to postpone till night.[31]

A similar episode is reported at Cambay during Jahāngīr's reign when a picture of adoration was exhibited in the Church and drew a crowd of 13,000 people within thirteen days.[32]

Such enthusiasm was perhaps caused more by devotional feelings evoked by visual contact than by a genuine interest in foreign art *per se*; nevertheless, occasions like these did provide opportunities to a large cross-section of people to get an exposure, however brief, to European painting.

It has been suggested that a large number of European specimens available in India in this period were prints published by the Plantin's firm at Antwerp for religious propaganda.[33] Besides these prints, books, woodcuts and engravings, silken and woollen tapestries 'worked with stories from the Old Testament'[34] were also brought here.

Before we move on to other aspects, it may be added that acquisition of European paintings by Indians was through presents or purchase. We do not hear of the sovereigns buying

paintings; but Shāh Jahān, when a prince, is reported to have purchased a painting of Diana for seven hundred *mahmūdīs*.[35] In 1621, the English factors wrote from Āgra that 'pictures they will sell at the best rates possible'.[36] Their only grievance, as they reported from Sūrat, was that 'no profit to be made on the sales will recompense the trouble of getting them through the custom-house'.[37]

TYPES OF PAINTINGS

The thematic content of European paintings brought to India may be broadly divided into two groups: (a) religious or sacred, and (b) secular. The first category consisted of themes related to the Old Testament, the legends connected with the life of Christ, the evangelists and saints; the second category comprised classical, allegorical and general themes.

Themes from the Old Testament—pictures of Adam,[38] Noah,[39] Moses,[40] Sarah (wife of Abraham),[41] Daniel in the Lion's Den,[42] The Angel of Tobias,[43] Expulsion from Paradise,[44] etc. could easily be traced, but others such as Creation or Adam and Eve only in one composition appear to be very rare. On the other hand, legends from the New Testament form the bulk of the European paintings available to the Mughal court artists. The spectrum of such themes was very broad:[45] Holy Family, Annunciation, Angels Appearing to the Shepherds, Cleaning the temple of Bethlehem, Nativity, Adoration, Presentation to the Temple, Christ in Wilderness, Christ's entry into Jerusalem, the Last Supper, Scoffing, Crucifixion, Descent from the Cross, Lamentation, the Last Judgement, Resurrection, etc. A word about Crucifixion; Maclagan wrote in 1932: 'Of the Crucifixion itself—a subject common in Europe—there seems to be no example among the Mughal miniatures; an omission which is probably due to the repulsion with which the incident was always regarded by Muslims.'[46]

The second part of this statement is true: the Qur'ānic stand is that Christ was not crucified but raised to heaven by God.[47] Popular legend has it that in Christ's place someone else resembling him was hauled up on the Cross. But the first part of Maclagan's statement has no validity now. However, it must be conceded that compared to other themes, especially of the

Madonna and Child, Mughal paintings have so far yielded very few examples relating to it. On the other hand, the latter theme, that is, Madonna and Child, appears to have been very popular with the Mughal art patrons. In fact, the Qur'ān invests Mary with unique status: she has been chosen by God as the purest and highest among women of the world.[48] It is said that when the Prophet Muhammad conquered Mecca, he instructed that all pictures in the Ka'ba be erased except one of Mary with the infant Jesus.[49] Later, this painting was lost in the fire at the Ka'ba in A.D. 683. The Madonna theme had many variations:[50] Madonna by the tree, Madonna on the bed, Madonna with a rose, Madonna on the snake, Madonna on the Crescent, Madonna on the rock, Madonna feeding the infant Jesus, etc.

Works pertaining to the miracles[51] of Christ were also brought, namely, Christ stilling the storm, Widow's dead son regaining life, the Revival of the daughter of Jarius, etc. Again, themes relating to the parables[52] too were available; for example, The Good Shepherd, or the parable of the weeds. Among the Christian saints,[53] pictures of John, Matthew, George, Cecilia, Jerome, Magdalen, Margaret and Catherine may especially be mentioned. Paintings based on Classical themes were also known in India:[54] Mars, Venus, 'Venus and Cupid actes', Diana, Judgement of Paris, Neptune, Plato charming the animals with his music, etc.

It seems that the English Company sent a large number of allegorical pictures, viz. 'Venus and Satyr', and 'Expressing our Government'.[55] Besides these two, many other such figures are also traceable.[56] The general paintings included portraits of sovereigns, the governor of the English Company, the Pope, European ladies and gentry;[57] also, depictions of battle-scenes, comic incidents, nude figures,[58] animals[59] and innumerable other themes.[60]

It is important to point out that a large number of the European paintings and engravings were either carefully copied or adapted and modified, or reinterpreted by Indian artists. At the same time, many 'original' prints found their way into the albums of art patrons, especially those of Jahāngīr and Dārā Shukoh.

MAIN ASPECTS OF MUGHAL PAINTING

'The whole of Asian painting', says Hajek, 'between the 16th and 18th centuries, at some or other time, shows the results of contact with European painting, although in many different ways. But the European style almost certainly attained its greatest influence in the Mughal miniature, where some of its techniques were completely absorbed.'[61] Before we endeavour to trace the elements of impact 'in many different ways', it would be useful to sum up the salient characteristics of Mughal painting prior to its response to European forms.

Influenced as it was by the Persian style, Mughal painting was essentially a two-dimensional art. Thus, in depicting a distant background, Indian painters, since their concept of 'spatial design' was different from that of Europe, did not employ the principles of perspective. It has been suggested that perspective in Indian art is 'felt' rather than 'drawn'. In Europe, Paolo Uccello is credited with having 'discovered' perspective during the Renaissance; nevertheless, Leonardo da Vinci formulated rules of perspective with almost scientific accuracy. Leonardo remarked that perspective is the 'bridle and rudder of painting'. He divided it into three parts: first, the *linear perspective*, that is, the diminution in the size of opaque objects; secondly, the *perspective of disappearance* or vanishing perspective which treats of the diminution and loss of outline; and thirdly, the *perspēctive of colour*, that is, the fading and loss of colour at the farthest end. He also discovered the effect of atmosphere on the colour of distant objects, i.e. changes to blue in proportion to distance. He, therefore, insisted that painters should be careful about agreement between the perspective of colour and the size of objects. Actually, the effort of European artists since the Renaissance has been towards the representation of a scene in a way that corresponds to our 'visual impressions', or in other words, as it would appear in nature.[62] Havell remarks: 'It is just in this different idea of realism and different outlook upon nature that we find the gulf which separates Eastern art from the academic art of Europe.'[63]

One of the results of the lack of perspective was that in a single composition the spectator was provided with several standpoints to view a scene simultaneously. Since Indian

artists did not have much knowledge of shading, the figures and objects lacked depth and volume, thus giving them a flat appearance. The absence of shading might have been due perhaps to an excessive reliance on calligraphic line drawing.

Indians proved deficient in yet another area, that is, the treatment of light and shade or chiaroscuro. Moreover, the concept of objects casting shadows did not exist.

Of portrait painting, it has been observed that it was a 'prominent feature in much of the art of Asia, but nowhere was it more highly developed than in the paintings of the Mughals'.[64] What interests us, however, is the depiction of the face. It is true that in the West and the East, the profile—'the most typical aspect of the face'—was perhaps a very old convention, more easily executed than a frontal or three-quarters view which was fraught with difficulties like foreshortening, shading, etc. But very soon European painters, especially during the sixteenth and seventeenth centuries, turned their attention to the three-quarters or frontal delineation of the human face. This development did not occur in Mughal portraiture with the result that one generally meets with expressionless faces and stereotyped gestures.[65]

In depicting the human form as a whole, Indian artists betray an almost total ignorance of scientific anatomy even though Indian art, at least in sculpture, has had a long tradition of nude figures. Mughal paintings scarcely portray the human form in terms of muscular articulation. In contrast, Europe had a continuous Greek tradition of portraying the human body with careful delineation of the muscular structure, which was transferred to the realm of painting during the Renaissance.[66] Leonardo da Vinci offered the following advice:

> It is necessary for a painter, in order to be a good draughtsman of limbs in all the positions and actions of which they are capable in the nude, to know the anatomy of the nerves, bones, muscles and tendons, so that he may know in each movement and exertion which nerve or muscle is the cause of such movement, and make only those prominent and enlarged, and not others at all places . . .[67]

Incidentally, the advice of this multi-dimensional personality was based on firm foundations: Leonardo da Vinci had dissected more than thirty corpses.[68]

NATURE OF IMPACT

Broadly, we are able to identify three trends in the continuing process of European impact on Mughal painting: first, imitation or attempts at faithful reproduction; secondly, adaptation or incorporation; and thirdly, acceptance of certain techniques and motifs. However, this does not imply that these three trends necessarily occurred in linear progression; they tended to overlap.

Imitation

It is not difficult to visualize from what has been said in pages 86–9 that Indian artists had ample opportunities for intimate contact with specimens of European painting. For example, the seven volumes of Plantin's Polyglot Bible, though containing frontispiece illustrations only, were kept in the Imperial library for fifteen years, and we can reasonably expect the artists of Akbar's court to have had frequent opportunities to study them. Similarly, other illustrated books or independent paintings and engravings must have come under their purview. When the Madonna del Popolo was exhibited at Āgra, Akbar commissioned all the best painters of the town to copy it, but, as the Jesuits exaggeratedly tell us, they confessed their inability by declaring that 'such perfection of portraiture was beyond their skill, and that they were unable to compete with the Portuguese in this part'.[69] In 1588, Kesū, one of Akbar's court painters, prepared an album which included several copies or imitations of European specimens.[70] In 1598, the painters under Prince Salīm (Jahāngīr) were found copying some European paintings.[71] Commenting on the Christian themes painted on the walls and ceilings of the Imperial palace at Lahore, Father Xavier observed:

> He [Jahāngīr] had ordered his artists to consult the Fathers as to the colour to be given to the costumes and to adhere strictly to what we told them. The figures to be painted were selected by the King himself from his collection of prints [registors] and he decided where they were to be placed. He got his painters to make large-size sketches on paper of all the prints which he wished to have painted and the Fathers then stated how the painting should be done.[72]

Not surprisingly, therefore, Mughal court painters acquired

skill in 'line-for-line'[73] imitation of European pictures to a degree which once baffled Sir Thomas Roe when he was asked by Jahāngīr to pick out the original European specimen placed alongside a few imitations.[74] Rightly, then, Roe remarked that 'for indeed in that art of limninge his Paynters woorke miracles'.[75] Terry, commenting on this aspect, observed that 'They are also excellent at limning and will copy out any picture they see to the life'.[76] We are told that Shāh Jahān had 'every European painting which he could copied by his court artists'.[77]

A slightly different aspect, though in the category of imitation, was the practice of 'quoting' bits and pieces from European pictures.[78] More often than not, such 'quotes' were incorporated in the margins of manuscripts, partially enclosing a piece of calligraphy.[79] Sometimes, a European architectural design is shown in the background of an otherwise purely Mughal composition.[80] On other occasions, a 'bit' is transported quite unintelligently from a European picture to an Indian painting depicting some story;[81] or, European engravings are meaninglessly pasted, for example on the upper part of an Indian painting showing the portrait of Ibrāhim 'Adil Shāh II.[82]

Adaptation and Incorporation

On numerous occasions, the Indian artist endeavoured to eschew his role as a mere faithful copyist, and this led him to certain experimentation, the results of which were not always artistically happy. For example, the Indian artist might choose a theme from a European picture and then attempt to portray it in terms of his own technique or conventions by, say, giving the figures Indianized costumes and gestures, not in keeping with the original model;[83] or, while the figures retained their European iconography, the total effect of the scene was Indian in its background and mood.[84] At times, both the theme and composition are inspired by a European model, but the painting is not faithfully executed.[85] Once, it appears, a parody is attempted while portraying the Virgin and the Child: two European figures drinking wine are shown in the foreground.[86] Here, in all probability, the artist has brought two separate 'bits' together to create a new setting.

Response to European Techniques and Motifs

Perspective. Indian artists were quick to notice the difference between their two-dimensional paintings and the three-dimensional European ones. They soon began to appreciate both the linear and atmospheric perspectives. Welch remarks that 'the Mughals were the first in the Islamic tradition to violate the purity of page design by painting the third dimension'.[87] Earlier, the use of a distant background is occasionally visible in the *Hamza nāma*; but it was only after 1575 that the elements of perspective began to be consciously employed on a modest scale.[88] However, this does not imply that the entire composition of an Indian painting in which scientific canons of perspectives were taken account of was necessarily executed wholly in the European manner. For example, one might find elements of *dūr numā'ī* (distant perspective), yet the treatment of rocks might be Persian;[89] or the architectural landscape depicted under European influence and the foreground purely in the Mughal tradition.[90]

Of the Akbarī artists, Basāwan towers over others in his almost uniform and conscious application of European perspectives. Perhaps the best example from Basāwan is the painting showing a figure running away from a *darwesh* with a distant background which is in almost total conformity with the principles of perspective evolved in the West.[91] By comparison, another Akbarı artist, Miskin's attempt at diminution, depth or colour-change is not entirely happy.[92] It must be conceded, however, that themes of meetings with an ascetic or a learned person furnished opportunities to Indian artists to grapple with the depiction of distant background with depth and perspective under the influence of European tenets.[93] This holds true also of hunting-scenes where a large stretch of space is covered showing objects in diminution.[94]

Light and Shade. Another European convention acceptable to Indian artists was chiaroscuro. The principles of light and darkness were essentially utilized in the night-scenes. Binyon's remarks may be recalled here:

> European influence is obvious in those frequent night-scenes where guests are seated round a fire, their faces bright and their backs in

shadow, or the hunting scenes where lanterns are used to daze and fascinate the quarry. The truly Indian—the universal Asian—way of treating a night-scene is to paint the figures just as clearly as if it were daylight, but to paint the starry or moonlit sky above them.[95]

Perhaps one of the earliest attempts at fire-lit scenes is that by 'Ināyat.[96] There can hardly be two opinions that whatever attempts were made by the Indians in this direction were feeble when compared with the realism attained in the European paintings, e.g. the works of Hendrick Terbrugghan ('The Concert' and 'The Procuress'), or Pieter Claesz ('Still-life with a Candle').[97] Indeed, one would look in vain for an Indian comparable to Willem Kalf who experimented with the behaviour of light in relation to its reflection and how it was broken by coloured glass.[98] Nevertheless, Indian painters occasionally did try to represent chiaroscuro in accordance with their own understanding of the technique,[99] though there was no attempt 'to master the Western manner'.[100] Shadow cast by light eluded Indian artists in its entirety,[101] as did reflection in water. A very late example of the latter comes from the Kangra(?) school of painting in the 1780s.[102]

Another European technique, that is, shading, attracted Indians, though it was generally used for projecting volume,[103] for example, the figures of elephants.[104]

Portraits. The weakness of Indian artists in portraying the face in profile in general continued throughout the period under review.[105] While the three-quarters technique is occasionally met with, frontal depiction is uncommon. Basāwan's attempt at a frontal view and foreshortening in one of his works is a rare phenomenon indeed.[106] Besides this, we could trace three more such endeavours worthy of notice.[107]

Profile-portraits were incapable of showing perceptible facial expression. But on certain occasions when the Indian artist drew the face in three-quarters, he endeavoured to free himself from the strait-jacket of stereotyped gesture or rigid and inane expression. Perhaps one such example is the portrait of Muhammad Rezā Kashmīrī by Bichitr: it represents a blend of European influence with some traces of indigenous technique.[108] Yet another portrait by Bichitr, of a *kamāngar* (bowmaker) showing the effect that the music played by one has on another, is a

rare study.[109] Basāwan's dying *yogī* in a composition depicting Akbar watching a fight between rival bands of *yogīs* is yet another example of the artist's freedom from insipid portrayal.[110] Perhaps the 'Dying Man' also could be referred to as a study of the last sombre moments of an opium-eater and wine-bibber.[111] But such specimens are hard to come by, thus corroborating Bernier's remark that Indian painters were deficient 'in the expression of the face',[112] and Thévenot's that 'they make faces ill'.[113]

Coming to the human or animal form, it is clear that Indian artists refused to learn the principles of muscular articulation from Europe. This lack of skill might have been partly due to the comparative non-availability of European pictures which emphasized this aspect; but more than this, it might have been the result of the absence of practical knowledge of anatomy and scientific observation among Indian artists.

Compare, for example, Bernier's statement:

> It is not surprising that Gentiles understand nothing of anatomy. They never open the body either of man or beast, and those in our household always ran away, with amazement and horror, whenever I opened a living goat or sheep for the purpose of explaining to my Agha [Dānishmand Khān] the circulation of the blood, and showing him the vessels discovered by Pecquet, through which the chyle is conveyed to the right ventricle of the heart.[114]

Nevertheless, elephants received realistic treatment, while the horse had yet to go a long way, although it had emancipated itself from the earlier 'calligraphic' Persian style.

Yet, the reponse to some European motifs is heartening. The most significant ones are the halo or nimbus, winged cherubs or angels, and roaring or billowing clouds. It is true that the nimbus is originally found in Buddhist art in India, but it cannot be gainsaid that it came to be used in the Mughal school under the direct influence of European art. It is also true that the halo could be found in the Persian and Turkish schools of painting, especially in portrayals of the 'holy family of Islam.'[115] But the difference between the Turkish and Persian halo, and that adopted from European models, is clearly discernible: the former schools symbolize it by a golden flame or flaming dispersed halo, totally different from that adopted from Europe.[116] Actually, the halo begins to occupy the stage only with the

reign of Jahāngīr when there prevailed very strong European artistic influence. Since use of the halo, with occasional exceptions for holy personages, was confined to portraits of Mughal Emperors, we may infer that this idea of 'apotheosis' was purposely initiated by Jahāngīr to draw a sharp line between royalty and the rest:[117] even the 'puritan' Aurangzeb stuck to this symbolic deification. We may also draw attention to the types of halo, that is, with thick and thin radiating rays, and also the halo of a resplendent sun and moon.[118] The latter was undoubtedly independently developed by Indian artists.

It is true that winged angels could be traced to Persian paintings.[119] But, once again, the angels and cherubs adopted from the European specimens by Indian artists are readily distinguishable from the Persian ones. Indeed, one may sometimes find the Mughal cherubs bearing a resemblance to Raphael's winged cupids with bows in 'The Nymph Galatea'.[120] Mughal cupids, angels or cherubs are generally depicted nude or scantily dressed, with bows and arrows on many occasions, or offering a sword or crown to the central figure in the composition.[121] It must be pointed out that such motifs appear with greater frequency during the reign of Shāh Jahān, and at least two artists, Bichitr and Abul Hasan, could be credited with having made this practice a popular one. It was also during this period that rolling and billowing clouds replaced the Chinese and Persian cloud-motifs.[122] An artist, Muhammad Zamān, sent by Shāh 'Abbās II to Rome, later joined Shāh Jahān's court and exploited his occidental training in depicting flying angels on billowing clouds.[123]

The European skill in depicting folds in the drapery was carried to amazing heights. Indian painters could see this convention, for example, in European specimens portraying the Virgin. It may be possible to trace its acceptance in a few Indian compositions,[124] but its occurrence is so rare that we are obliged to conclude that this convention did not elicit much response.

Genre Paintings. F. R. Martin is of the opinion that Mughal painters took to genre paintings under the influence of Europe by A.D. 1650.[125] Although China had an ancient tradition of landscape painting, it is surprising that India did not borrow it

from her. In contrast Europe 'witnessed a remarkable extension of landscape painting' in the opening years of the seventeenth century.[126] It is well known that the Dutch had developed this type of pa·nting to a height that earned them world-wide applause.[127] European contact, especially under the influence of Dutch specimens, might well have inspired Indian artists; it appears this branch of painting never became a *distinct discipline* in their school of art.[128]

We do have landscape with animals,[129] with mystics,[130] with hunting parties,[131] etc; nevertheless, in general, Indian painters did not cease to treat landscape as mere background. For example, large independent landscape with light and shade did not attract the Mughals; indeed, it is impossible to find any Indian specimen comparable to, say, Jacob Issaksz van Ruisdael's 'Wheatfields'.[132] Only one example of Mughal landscape painting has been traced depicting 'Woodlands', directly under the European impact, probably after an engraving of a Dutch painting.[133]

Allegories. We have shown above that some allegorical pictures were also brought to India, especially by the English. Did these specimens inspire Indian artists? We are of the view that at least one or two Mughal painters, especially during Jahāngīr's reign, show some *faint* influence of this type of painting, though after their own fashion. For example, Bichitr's 'Jahāngīr preferring a Sūfī Shaikh to Kings' could be placed in this category;[134] or, Abul Hasan's composition showing Jahāngīr shooting arrows at a human skull and an owl is clearly a symbolic representation.[135] With some reservations we might also include Abul Hasan's 'Jahāngīr's Dream of Shāh 'Abbās', and also 'Jahāngīr entertains Shāh 'Abbās' by an anonymous artist.[136]

Talking of symbolic representation, it must be pointed out that Indian artists liberally turned to account the idea of the globe—a European cartographic importation—to emphasize the Mughals' temporal power.[137] Also, a rare depiction of the European hour-glass to symbolize the running out of time should be noted.[138]

Equestrian Portraits. Some disagreement exists among Mughal

art connoisseurs about the possible influence of European painting on Indian equestrian portraits. Percy Brown for instance holds that the idea is entirely an Indian one;[139] while Martin is convinced that Indian artists borrowed it from Europe.[140] We feel that though the tradition of equestrian portraits may be traced to both the Indian and Persian history of art, the attempts made were feeble and unhappy; perhaps the trend towards realism ushered in through European influence gave Indian equestrian portraits elements which were different from earlier examples, at any rate, in terms of treatment.[141]

Depiction of the Female Figure. The opinion that Mughal painting was 'essentially a masculine art'[142] paying little attention to the lives of women, or that it had little 'romantic flavour'[143] is tenable to some extent only. Manucci correctly observes that there was no question of portraits of queens or princesses since it was not possible to see them, but those of concubines and dancing girls, he concedes, were drawn by the 'artist's fancy'.[144] That the portraits of the latter group of women in Indian society was an indigenous development without alien impulse is quite obvious. But what about the nude or semi-nude paintings of the fair sex? We have related above that Pelsaert in 1620 asked his countrymen for nude pictures to be despatched to India. We also know that paintings portraying the 'acts' of Venus and Cupid were in demand among the higher classes. Thévenot, commenting on Indian paintings available in Āgra during the second half of the seventeenth century says; '. . . they were for the most part indecent and represent lascivious postures, worse than those of Aretin, there are but few civil Europeans that will buy them'.[145]

Could we, then, infer that such paintings were probably executed under the inspiration of European examples? If we can, we should also note that such works were the work of 'bazar' artists. We have yet to discover a specimen from the brush of the court painters answering Thévenot's description. However, a semi-nude portrait of a woman with bare, round and full breasts attributed to Govardhan exists.[146] It is possible that the idea of bare breasts in this painting originated from some European specimen of the Virgin and Child, probably from the Netherlands.[147] But the suggestion that the Indian artist may

have been inspired by a secular European model from Cornelius Jacobsz Drebbel's 'Poetry' sounds more logical. The Indian adaptation has been slightly modified and reversed.[148]

Oil-painting. In furtherance of the European drive to achieve realism in painting, while Uccello chose the principles of perspective later developed by the Florentine painters belonging to Brunelleschi's circle, Van Eyck pioneered another path by creating the 'illusion of nature' for which he invented oil-painting. Actually, he gave a new turn to the preparation of paints by abandoning the use of eggs in pigments derived from vegetable or mineral ingredients; instead he added oil which did not dry up as quickly.[149]

When Sir Thomas Roe presented a picture in oil to Jahāngīr, 'being in oyle he liked it not'.[150] This imperial rejection seems to have infected the artists too, and it is impossible to point out any specimen in oil executed by Indian artists during our period. Though there is no record to indicate that Jahāngīr or any other Mughal Emperor put a ban on this technique, the total indifference of the court artists to oil-painting may partially be attributed to the absence of positive encouragement from their patrons. But other factors too might have contributed. For example, we must ask what the frequency of European specimens in oil available to Indian painters was. If we are permitted an impressionistic opinion, it may be argued that engravings were the dominant influence. We have shown above that Jahāngīr asked his artists to learn colour-schemes from the Jesuits, but as the account goes, this practice of learning from the latter did not extend to oil-painting. Earlier, when Abul Fazl says that much improvement was brought about in the formulation of pigments,[151] this by no means implies oil-preparations. Perhaps the subtle pervading calligraphic spirit among Indian artists was an inhibiting factor. Moreover, since canvas did not find acceptance, oil-painting was not easily compatible with the 'oriental artist's medium'.[152] It may be some consolation that the Chinese also did not take to oil-painting,[153] although the Japanese are reported to have done so under European influence.[154] We do not know what to make of Martin's statement that Indian artists tried to imitate blackened European oil-painting when they sometimes allowed figures 'to

stand out against an almost black background of luxuriant foliage'.[155]

Engravings. Above, we have referred occasionally to European engravings. The medium for these was both wood and copper.[156] It was perhaps in the fifteenth century that woodcut became a popular agency for multiplication of pictures, especially with the invention of printing in Europe. Very soon, copper-engraving came to occupy a dominant position because, once this craft was mastered, its results in terms of detail and effects were far superior to those of woodcuts. Actually, copper-engraving is a 'negative' of the woodcut in the sense that the latter is made by cutting away everything except the lines desired to be shown, the former by cutting only the artist's drawing.[157]

There is no actual evidence of the attempts of Indian artists in this field. But, curiously enough, Thévenot informs us that 'there are some at Dehly who Engrave indifferently well also; but seeing they are not much encouraged, they do not apply themselves to work, with all the exactness they might; and all their care is to do as much work as they can, for present Money to subsist on'.[158] Was this lack of encouragement or patronage universal for all the artists, since Thévenot was writing during the reign of Aurangzeb, or was it confined to engravers only? If the opinion of the Mughal art experts—that Mughal painting suffered a partial eclipse under Aurangzeb—is considered valid, we may infer that the absence of patronage which Thévenot speaks of does not relate to engraving *per se*. It was hard luck for the artists that they took to this branch of art during Aurangzeb's reign, and not earlier. At any rate, Thévenot's statement is very valuable since it is the *only* evidence[159] that records the existence of the practice of engraving, particularly since no specimens have so far been traced. It must be stressed, however, that these engravers of Delhi must have been 'bazar' artists rather than the court painters.

REGIONAL SCHOOLS

The period under review saw the rise of two prominent schools of painting, that is, Bījāpūr and Golconda. As a whole, it

appears that it was the former that was more influenced by European art than the latter.

Broadly, there were two courses through which European paintings exercised their influence: first, the Portuguese and Dutch settlements on the western and Coromandel coast; and secondly, the Mughal school which had already in a large measure accepted some European elements.[160]

Concerning the nature of impact, we find that attempts at exact copying or imitation were fewer than free adaptations. For example, in the 'Madonna and Child', while the folds of drapery and mannerism have been borrowed from a European model, the iconographic treatment does not indicate European inspiration. Moreover, Mary's robe is not blue, and the halo has been eschewed. In another painting with a similar subject, while the figure bears European elements, the landscape in the background, ornaments, carpet and flowering plants betray indigenous conception.[161] In yet another Christian theme (Holy Family), we find that a European figure with gloves, boots and a hat has been 'quoted', but the faces of the other figures resemble those in some Deccani paintings.[162] A few European motifs like winged angels and crowns were accepted,[163] but the use of the halo was on a much lower frequency than in Mughal art. This also applies to the globe which was probably never employed in the Deccan school. At times, shading and lines of perspective were experimented with,[164] but the results were feeble and unsure in comparison with Mughal paintings. However, a few secular and religious paintings indicate faithful attempts.[165]

One may ask why, in spite of the proximity of the European settlements, the Deccan school did not respond in the same way as the Mughal school? A partial explanation may be that the Deccan sultans' courts did not attract first-rate artists; but more important than this, it is probable that the artists were not consciously encouraged by their patrons to appreciate exotic innovations as they were at the Mughal court. Thus, it is correct to maintain that no 'wilful force was dictated by the personal predilections of any of the rulers' of the Deccan states to their artists.[166] It could also be suggested that Persian traditions in the Deccan school were too strong to admit of alien elements easily. Finally, the comparative absence, at the initial stage, of

line-by-line imitation of the European specimens might have contributed to the failure of the Deccan artists to fully understand the principles of European art.

There is not much to say about European impact on local schools of painting,[167] except that the Rajput school might have been marginally influenced.[168] Perhaps the relative geographical and cultural isolation of most of these schools hampered any significant development in this direction.

Before we take leave of this section, a few words may be said about textile painting (free hand, not block printing) in India, especially during the second half of the seventeenth century. It is well known that Indian textile products were in great demand in many parts of the world. The Indian artisan on his part rose to the occasion and produced fabrics corresponding to the tastes of the various markets—Indian, Persian, European, etc. When producing artefacts for the European market, the artisans were furnished with musters or patterns by the European buyers in accordance with trends in fashion and taste current in their countries which the native weaver-artists imitated closely or sometimes freely adapted. John Irwin has ably brought together many such examples in a study on Golconda cotton paintings.[169] The painted wall-hangings and coverlets to a large measure depict European designs, motifs and figures, including equestrian ones, copied from musters supplied by Western customers.[170] In paintings for other markets, one may detect an occasional acceptance or incorporation of European elements: for example, the Italian reversed-scroll motif on a coverlet meant for Persian clients,[171] or fantastic beasts, apparently under the influence of 'European heraldry', on a wall-hanging for the Mughal market.[172] An elaborate study of the same theme, carried well into the eighteenth century, has been made by Irwin and Brett in a monograph entitled *Origins of Chintz*.[173]

ARCHITECTURE

The material at our disposal shows that Europeans erected buildings of several types, e.g. houses, churches, colleges, monasteries, nunneries, tombs, fortresses, castles and barracks at their places of settlement in India,[174] largely along the coastal regions. A large number of these buildings were built after the

model of some building in Europe, or, in any case, conformed in appearance to European designs. Early in the sixteenth century it was noted that the 'temples' of 'Christians' at Goa were made like 'ours' with one or two exceptions.[175] Pyrard noted about Goa that it 'contained a number of forts, churches, and houses built in the style of Europe'.[176] Again, the little church of the 'Theatins' at Goa was reported to have borne a resemblance to St. Andrew della Valle in Rome.[177] At Cambay, we are told, the Portuguese built houses 'after the manner of Portugal',[178] while the church and monastery at Bassein were built 'after the manner of Europe'.[179] During the second half of the seventeenth century, the Danes erected a fortress with towers at Tranquebar 'in the Danish style'.[180] In Bombay, the English built barracks 'in imitation of Chelsea College'.[181] They also built a fort (St. George) at Madras 'in the European manner'.[182] Houses were built at Pulicat in the Dutch style in the Dutch quarter of the town.[183]

It is evident that all the places mentioned above were, at some time or other, under the direct political or administrative control of Europeans. Of Sūrat it is reported that the European companies' staff lived in hired houses, because the Mughal Emperor did not permit 'any Frank to possess a house of his own, fearing that he would have that of which he might make a fortress'.[184] Actually, the houses the English lived in at Sūrat were partly the 'King's gift' and partly hired,[185] 'contrived after the Moor's buildings'.[186] However, the Capuchin Fathers at Sūrat were successful in having built a 'very commodious' house with a beautiful church on the 'model of the houses of Europe' by circumventing the prohibition through a clever ruse.[187]

Indian masons must inevitably have been associated with these building activities. Pyrard wrote about Goa: 'The buildings of these churches and palaces, both public and private, are exceeding sumptuous and magnificent; the work is done for the most part by the Canarins, both Gentiles and Christians . . .'[188] Earlier he noted that the artisans at Goa, who were mostly Indians, were organized under 'a grandmaster, called Mayor, who is a Portuguese, having command over those only of his own art'.[189] Indeed, we are told that the Danes engaged Indian master-masons at Tranquebar to build a fortress under their

direction in the Danish style.[190] It seems that Indian masons' exposure to European influence in this sector was confined largely to the coastal regions. It is probable that at Goa some Indian converts to Christianity attempted to imitate the Portuguese. The inland masons had fewer opportunities which may partly explain the indifference of inland people in the construction of European-style buildings.

The foreign travellers took note of two European architectural features—the chimney[191] and window-panes—which were either rejected totally, or accepted in a subdued way by Indians. For example, Terry says that Indians 'have no chimnies to their houses, for they never use fire but to dresse theire meate'.[192] Ovington explains the rejection: 'There is not any Necessity of Fuel in private Apartment, the Great Globe of Light is the universal Fire all over India, which cherishes and keeps them warm without any Expence of Chimneys or of Hearths in their Lodging-Rooms.'[193]

The use of window-panes had become widespread in Europe as a result of mass-production of glass.[194] Along with the glass-mirror, Europeans also brought the window-pane as an article of trade.[195] Initially, as a novelty, it did arouse avid curiosity amongst Indians. For example, Muqarrab Khān in 1618 desired to 'experynce the use thereof',[196] but his wish could not be fulfilled because there was no 'glasier' at Ahmadābād: he had left for Persia. The English factors expected one to be sent from England with the next fleet, but they were disappointed. They wrote in 1619, 'No glazier has come in this fleet, and so it is to be feered that windowe glass is useless'.[197] And soon, in another letter, they advised the Company against sending this article to India.[198]

We are not surprised, therefore, to find a recurrent observation of European travellers that windows in Indian houses are bereft of panes. Pyrard had noticed the absence of glass in Indian windows:

> The houses are covered with tiles, for window-glass is not employed; but in lieu thereof very thin polished oyster-shells, of a lozenge shape, and set in wooden frames. These give as much light as paper windows or horn lanterns, but are not so transparent as glass.[199]

Fryer says that Indian windows are 'usually folding Doore,

skreenked with cheeks, or Latises, carved in wood, or Ising-Glass, or commonly oister-shells'.[200] At Daman, a Portuguese settlement, 'curiously wrought and transparent' oyster-shells instead of panes are recorded to have been used during the second half of the seventeenth century.[201] Also, at Bassein, the 'fidalgos' owned 'stately dwellings' with large windows fitted with panes of oyster-shells which was the usual 'glazing among them in India'.[202] Again, at Bombay where the English had erected a few buildings, we are told about the use of shells instead of glass.[203]

It is fairly clear from the foregoing examples that Europeans in India used oyster-shells in place of glass implying that they did not import much of this commodity even for their personal use. One understands the choice of the indigenous material in the light of Fryer's remark: 'Glass is dear, and scarcely purchaseable (unless by way of Stambole, or Constantinople, from the Venetians), from whom they have some Panes of Painted glass in Sash windows.'[204]

Thus, the use of window-panes must have been confined to a small minority of Indian society.[205] Fryer himself says that only 'some few of the highest Note' used imported glass.[206] A contemporary observer suggests that the Indian windows did not have glass because they had to be kept open for the 'convenience of the fresh Air'.[207] This was true perhaps of the common people: the moderately wealthy groups put up lattices of *khas* and other such materials during the summer months.[208] Perhaps the want of 'glasiers' could have been yet another reason for its very limited acceptance even among the wealthier sections of society. That the demand for window-panes was very low, for example, even at Sūrat, may be inferred from the fact that there were only nine or ten 'well-built houses' there which alone might perhaps have needed this luxury.[209] And finally, Europeans in India themselves had not set an example for its universal use.

MUSIC

There is scarcely any evidence in this period to suggest the adoption of European music in all its essentials. Among the numerous European musical instruments brought by Hājī

Habībullāh in 1575 to Akbar's court from Goa, a special mention has been made of the Organ (*arghanūn*).[210] Badā'unī says:

> It was like a great box the size of a man. A European sits inside it and plays the strings thereof, and two others outside keep putting their fingers on the five peacock-wings [the bellows], and all sorts of sounds come forth. And because the Emperor was so pleased, the Europeans kept coming at every moment in red and yellow colours, and went from one extravagance to another. The people at the meeting were astounded at this wonder, and indeed it is impossible for language to do justice to the description of it.[211]

However, Akbar's interest did not go beyond being pleased with the organ for the moment. We do not hear of it again. Actually, the organ, with a chromatic keyboard similar to that of a piano, had an intricate mechanism[212] which must have deterred Indians.

Later, in 1612–13, English musicians played on virginals and other instruments before the governor of Ahmadābād and other officials 'which muzick they did verie highlie comend'.[213] Once again, we find Indians terminating their interest at the point of applause. On another occasion, however, an apparently encouraging response, though short-lived, is traceable at the court of Jahāngīr during the same period. Two Englishmen, Canning and Robert Trully, demonstrated their skill on the virginal and cornet respectively before Jahāngīr. While Jahāngīr disliked the 'faint watery' music of the former, he put the cornet 'to his mouth'. Later, he ordered six such cornets to be made. We are not told whether Trully himself accomplished the job or Indian craftsmen copied the original, but the imitations were not a great success. At the Emperor's request, Trully, a little unwillingly, taught the 'chiefest musician' how to play the cornet in five weeks and then his skill was displayed before Jahāngīr who was delighted. Unfortunately, the unnamed Indian musician died two weeks later 'of a flux'. With his death, the royal interest too evaporated, and Trully himself left the court.[214]

We can only guess that perhaps in those areas where the Europeans held political and administrative sway for a long time, for example Goa, Indian converts might have responded favourably to Western music. The reason for rejection may well be in the basic dichotomy between the European and Indian

musical systems—the former essentially founded on the principle of *harmony*, and the latter those of *melody*.[215] Nevertheless, it seems that some European instruments were used by Indians. For example, Abul Fazl, describing the musical instruments in Akbar's *naqār-khānā*, says that three kinds of *nafīr*—Persian, European and Indian (*'Ajamī*, *Faringī* and *Hindī*)—were blown as a matter of routine.[216]

CHAPTER IV

SOCIAL AND CULTURAL RESPONSE

LANGUAGE

When two culture-groups come face to face, differences in language tend to present an understandable barrier to a deep and meaningful process of mutual appreciation or cultural exchange. It is at such a time, i.e. at the initial stage, that linguists or interpreters have a very significant role to play. Since Europeans came to India with trading objectives, the task of middlemen between the indigenous and foreign merchants was taken over by Indian brokers. It seems that at the outset the function of an interpreter was performed by a specialized professional group of individuals called *dobhāshī*, but in course of time the tasks of brokers and *dobhāshī* merged. Thus, foreign merchants' dependence on indigenous brokers gave rise to a large number of middlemen who gradually acquired a good working knowledge of one or two European languages.[1]

The knowledge of European languages generally spread along the coastal regions, concentrating at large trading centres and, to a lesser degree, at big commercial towns inland. An interesting feature is the development of a kind of commercial language along the western coast: the result of a concourse of merchants of diverse nations. English merchants make it explicit that they conversed with their brokers and other persons in that language which for historical reasons bore in a large measure the impress of Portuguese. And that is why the English factors in 1634 designated it 'Negro Portuguese'.[2]

That the Portuguese language held sway throughout the two centuries under review in comparison to other European languages is a point worthy of consideration.[2a] This may be explained by the initial advantage that the Portuguese had of nearly a century of close contact with Indians prior to the

advent of other European nations. Besides, the large-scale conversions at places under direct Portuguese rule was an additional factor in the spread of the Portuguese language. However, we do not propose that all the Indian converts to Christianity took to Portuguese. But it may be said that converts drawn from the upper strata of society consciously learnt the Portuguese language,[3] perhaps to identify themselves more closely with the foreign ruling group.

As a matter of fact, Portuguese missionaries came to realize that proselytizing activity could be more fruitful if it was carried on through the Indians' mother-tongue. As a result, a vast Christian literature in Indian languages was produced by the Jesuit priests relating to catechism, lives of saints, sermons, etc. But it must be remembered that the Roman rather than the Devanagari script was used for printing it.[4] Some of these books included *The Christian Purana* (1616), *The Purana of St. Peter* (1619), *The Purana of St. Anthony* (1655), etc.[5] Books on grammar and vocabularies of Indian languages were also published,[6] thereby laying the foundations of 'oriental studies'. Notwithstanding the development of Indian languages and dialects (Konkani and Marathi) under the Portuguese, we find an undercurrent of resistance on the part of the Portuguese clergy at Goa to obey decrees which made the knowledge of Indian languages compulsory. It was only in 1684 that the use of Indian languages in places under Portuguese sovereignty was prohibited for contracts and other legal dealings.[7] Despite favourable official policy towards the development of Indian languages and the absence of forceful imposition of the Portuguese language, at any rate till 1684, it is interesting to notice the degree of extension of the latter amongst Indians, sometimes even at places not under Portuguese domination.

In 1609, when the English met with two or three Indians at Gandevi on the western coast, they found them speaking Portuguese.[8] In 1612, we are told about a broker named 'Jadoa' at Sūrat who 'spok verie guood Porttingaille'.[9] When the English captured seven slaves after pillaging three Mālābārī junks in 1613, it was recorded that they could converse in the Portuguese language.[10] Again, in the 1670s, some fishermen, working between Ceylon and Cape Comorin, are mentioned as having talked in 'broken Portuguese'.[11] About Tranquebar, during the latter dec-

ades of the seventeenth century, Olafsson remarked: '. . . Portuguese is generally spoken there, as much by the Indians themselves when addressing strangers as by the Spaniards themselves, and so it is mixed with Indian and everything corrupted.'[12] Besides, Olafsson lists Portuguese words which had become current, if slightly corrupted,[13] among the local people.

Thus, Charles Lockyer was not wrong when he said in 1711: 'The Portuguese may justly boast they have established a kind of *lingua franca* in all the sea-ports of India of great use to other Europeans who would find it difficult in many places to be well understood without it.'[14]

As a matter of fact, as Boxer says, Portuguese was at that time the commercial *lingua franca* of the Far East, to such a degree that even the Japanese could speak and write it.[15] Perhaps the acquisition of Portuguese was largely facilitated by intermarriage and social intercourse, both in Japan and India (see below).

In comparison with Portuguese, other European languages barely attained a reasonable degree of acceptance among Indians, except perhaps English which, at least at Sūrat, appears to have had a wider circle than French or Dutch. Incidentally, an early specimen of spoken 'Indian English' has been recorded by an English chaplain (1689). He mentions a *bania* of Sūrat who, being constantly confronted with the 'feuds and jealousies' of his two wives, commented on the practice of monogamy among the Christians: 'English fashion, *sab*, best fashion have, one wife best for one Husband.'[16]

During the same period at Bombay, we are told of a Brahman who acted as the 'scrivan' to an Englishman and wrote 'very good English'.[17] In the 1670s some Indians were heard speaking English at Masulipatam.[18] The French came late (1660s), and this perhaps explains the slow spread of their language. But it is difficult to explain the relatively lesser use of Dutch whose arrival in India preceded even the English. One might encounter a Hindu interpreter in Dutch at Vijayanagar,[19] but it sounds strange when it is reported that Dutch priests had to carry out their religious rituals in Portuguese also for the benefit of the Indian Christians on the Coromandel coast.[20] In Japan, astronomers, scholars, cartographers, etc., who might have made good use of the 'materials afforded by Western science,

were not allowed to learn Dutch . . .'[21] We have referred to the 'secretiveness' of the Dutch people (Chap. I, pp. 18–19); this might perhaps explain the low currency of their language amongst Indians.

A curious fact has been recorded by Thomas Coryat (1612–17) about an Indian Muslim at Multān with whom he had an acrimonious religious dialogue in Italian. This Indian was once taken to Italy as a slave in a galley by some Florentines where he learnt 'good Italian' within two years.[22] But this was an isolated case since we hear nothing further of this language in India.

CONVERSION AND INTERMARRIAGE

The apocryphal story of Vasco da Gama having once remarked that they had come to India in search of Christians and spices in reply to his being asked about their motives,[23] might have lent some sparkle to Portuguese adventures at sea, but it would be incorrect to take the first part of his alleged statement at face value. Jesuit missionary activity was only a secondary act. Nevertheless, it should not be underrated since it added new dimensions to Indian society in certain parts of the country through conversions.

Conversions took place through force, inducement, and, occasionally also by voluntary change of faith.[24] It might not be true that the Portuguese policy of religious persecution of Hindus was not attempted outside Goa,[25] yet it could be said that, except the Portuguese, none of the European nations appear to have employed violence of similar magnitude.

The frequency of conversion was largely along the coastal regions, especially where Europeans held direct dominion; while the inland regions could claim only a sprinkling of converts,[26] perhaps more through inducement than coercion. Pyrard observed:

> There are Jesuit Fathers at the towns of Lahore, Dirly [Delhi], and Agra, though but few in each place. They have built churches, and have the liberty to preach and to convert as many as they can, so long as it be voluntary. Nevertheless, hardly any are converted.[27]

It also appears that since, comparatively speaking, conver-

sions were by and large the work of the Portuguese, more Catholics were inducted than Protestants.

Another aspect worth noticing is that during mass conversions, persons from the Hindu upper social hierarchy were much less evident than those from the lower levels.[28] Thus, it appears that conversion of the lower social groups was largely a group affair, while that of the upper ones, say, the Brahmans, was mostly a matter of individual change of faith.

Did Indians entirely sever their social and cultural moorings after accepting the new faith? For a long time conversion to Christianity as understood by the Portuguese did not mean merely a change of religion, but also a turning away from the Indian way of life, whatever that was, and adopting the Portuguese way of life instead. It is interesting that once the baptism of a large number of Hindus was postponed because clothes of the Portuguese fashion for the occasion were not available. The use of *dhotīs* and *cholīs* by male or female converts respectively was banned by the Inquisition.[29] One Jesuit writer amplified the whole affair thus:

> The Portuguese missionaries insisted that the neophytes should not only abandon their caste and the usages and distinctive marks associated therewith, but also adopt the customs, dress, language and names of their masters. They even went to the length of imposing on them the supreme insult of the use of meat diet.[30]

To what extent, then, was this policy successful? We find that, at any rate, with those Goan converts who were originally Brahmans, the impact was largely successful since they called themselves and insisted on others calling them 'Portuguese'.[31] But the situation was different at places where the Inquisition was not enforced, or the political grip was feeble. Indeed, mass conversions, especially when conducted through violence and other forms of coercion, did not yield the desired results. One is reminded of the story of the son of a *zamīndār* of Busna in Bengal (1670s) who, having been captured by Portuguese pirates, was baptized and given the name of Don Antonio de Rezario. The Jesuits put the conversion of 20,000 Indians in his *zamīndārī* to his credit. Commenting on this, Maclagan says:

> . . . these converts knew little or nothing of real Christianity, and were unacquainted with confessions, communion, or the Mass . . . No in-

struction and no persuasion could prevent them from maintaining their old Hindu customs; they sacrificed to idols and their marriages and funerals were conducted by Brahmans . . . many of the Christians had accepted baptism in the hope of getting sustenance.[32]

Similarly, an Englishman at Bombay (1690s) observed that the devotion of the native Christians was nothing but 'downright idolatry, having nothing but the name of Christians to distinguish them from heathens'.[33] Earlier, Pyrard noted that Indian converts disliked the change in clothing, eating cow's meat, and sometimes meat in general. For these reasons he called them 'Christians of necessity'.[34]

Moreover, conversion did not always obliterate ideas of caste, especially from the minds of the converts in Goa who were mostly drawn from the Brahman *varna*.[35] Pyrard wrote that the mesticos 'plume themselves much when their father or mother is of Brameny race'.[36] At another place he says that mesticos 'whose mothers are of a lower caste are not esteemed equal to those born of a Brameny mother, for these latter hold their heads as high as the Portuguese themselves'.[37] One may also refer to the two books written in the early decades of the eighteenth century —one by a Brahman, and the other by a Kshatriya convert— which carry polemics to establish the superiority of their respective *varna*.[38]

Whatever might have been the mechanism of conversion, it is difficult to indicate a conscious or deliberate opposition from the Hindu community.[39] For all practical purposes, Hindus looked upon conversion with nonchalance. But it was different with Muslims, at least in those places where the ruler was of Islamic persuasion. Pyrard says that the Jesuits in India lamented that it was more 'easy to convert fifty—nay, a hundred—Gentiles or idolaters than one Mahometan'.[40] Warning about delusions in reference to Muslim conversion to Christianity, Bernier remarked 'We do not adequately estimate the strong hold which the Mohomedan superstition has over the minds of its votaries'.[41]

Maclagan has concluded that the pace of conversion slowed down during Aurangzeb's reign,[42] indeed, even before him; one of the reasons that provoked Shāh Jahān to launch a serious attack on the Portuguese settlement at Huglī was the forcible conversion of Muslims by the Portuguese.[43] Thus, it is fair to

say that occasional resistance from the Muslims prevented European attempts at changing their faith, on a large scale at any rate.

On the other hand, open disputes between the numerous Christian sects might have somewhat retarded the pace of conversion. Manucci observed:

> Such disputes should be avoided; otherwise the Mahomedans and Hindus recently converted to our faith will begin to murmur on seeing such disorders, and little by little will forsake their new faith. Little store do they set by certain grand orators who preach the truth, but never act up to it. These converts begin to suspect that all must be a deception, and that in the Christian religion there is no truth.[44]

Nevertheless, the fear of diminution in the number of Christians in India was more than compensated for by the policy of intermarriage, that is, European males marrying Indian females. Indeed, Albuquerque was the architect of this policy; he even presided on such occasions. Those Portuguese taking Indian wives were granted dowries and allowed other privileges such as preference in appointment to petty offices or some portions of the conquered territory.[45] Often the membership of the *Senado de camera* (municipal councils) was drawn from those Portuguese who had married Indian women and settled down in Goa for life.[46] It is certain that marriages between Europeans and Indians were fairly common in some parts of the country.[47] The reason is obvious: European girls were in short supply in India.[48] This was largely due to the 'frontier milieu of continuous warfare' which did not encourage white women to go out to India: a ship carrying six or eight hundred males might have a 'dozen or so' women aboard.[49]

As a result, in relation to places under Portuguese jurisdiction, three terms came to be used to distinguish the three main social elements of Christian settlements. First, Reinos, those born in Portugal; secondly, Casticos, those born in Asia of Portuguese parents; and thirdly, mesticos, the offspring of mixed marriages.[50] The latter were also termed *topazes*[51] and, again, were called, perhaps in derision, *kālā faringī* (Black Europeans) by Indians.[52] Actually, this *kālā faringī* element was larger than the two others, and it constituted the backbone of Christian settlements, especially the Portuguese ones.[53]

Next, the Dutch also adopted the same policy when in 1614

they were permitted by their Company to marry Indian women on condition that the 'prospective brides must first accept Christianity'.[54] Very soon, in 1622, orders were issued that those who married non-Europeans would not be allowed to return to Europe. As a follow-up, the Company sent from Holland 'eighty young girls, who in time will make honest marriages in the Indies'.[55] But it seems that this interdiction became lax by the 1670s.[56] In reality, the 1622 order did not withdraw the permission for intermarriage: it only posed a threat. The second part of the ordinance ruled that henceforth no factor would be permitted to live with Indian women out of wedlock; the upshot was a number of hurried marriages.[57]

The first known British mixed 'marriage' was that of John Leachland and Manya, a native woman of Sūrat (1615–35). They had a daughter, named Mary, who subsequently married William Appleton, an English tailor at Sūrat.[58] Later, it was suggested that Protestant women should be sent to India because Englishmen often married Portuguese women or native Catholic converts, as a consequence of which their children were brought up in the Roman Catholic faith.[59] But it was discovered that European couples in India 'beget a sickly generation, . . . those thrive better that come of an European father and Indian Mothers'.[60] If the evidence of contemporary chronicles is to be believed, not many of those white women who reached India alive 'proved fecund'.[61]

FOOD, DRESS, MANNERS AND ETIQUETTE

Food

It may surprise many of us to be told that the present traditional excellence of and fondness for sweetmeats in Bengal is actually a contribution of the Portuguese. Bernier remarked: 'Bengala . . . is celebrated for its sweetmeats, espetially in places inhabited by Portuguese, who are skilful in the art of preparing them . . .'[62]

According to one contemporary estimate, there were about '20,000 Frangees of all sorts' in Bengal by the second half of the seventeenth century.[63] The bulk of this Christian population was made up of Portuguese deserters, bandits and mesticos who were mostly settled near Hugli and some at Rājmahal. When

not engaged in piracy, these Portuguese are reported to have been busy knitting 'stockings of silke and cotton; they bake bread for the English and Dutch factories and particular dwelling houses, and for theire ships and vessels'.[64] Besides, they made many sorts of sweetmeats of mango, orange, lemon, ginger, miraboli, ringo roôt, etc. At Goa, we are told, there were many kinds of confectionery which was consumed in great quantity.[65]

Did such European preparations reach the Mughal Court? It is reported that once in 1614 Āsaf Khān, the father-in-law of Shāh Jahān, gave a banquet for the Emperor at his palace when an 'abundance and diversity of the dishes and eatables' were served, including some in 'European style, espetially certain pastries, cakes and other sweet confections'.[66] These dishes were prepared by some slaves of Āsaf Khān's household who had served under the Portuguese at Huglī. These novelties were so 'admirably and delicately' made that the Emperor felt compelled to inquire about their origins.

Perhaps it is fair to infer that European sweets had become popular among all classes of people. There is however no evidence for the acceptance of European leavened bread or the loaf.[67]

Beer had come to India but was still a rarity for Indians. Jahāngīr must have heard of it. He therefore asked Sir Thomas Roe for details, and inquired whether it could be prepared in India.[68] Indians do not seem to have learnt its manufacture during our period. Even as late as 1689, a wealthy Indian of Sūrat, who was very friendly with the English there, would express his surprise that such a forceful liquid could be squeezed into a bottle.[69]

The Portuguese have been credited with bringing a variety of new crops and fruits to India:[70] among them, tobacco, pine-apple, cashew-nut and potato were the most important.

The best account of the introduction of tobacco and the subsequent growth of its consumption comes from two Persian sources—Asad Beg's memoirs and Sujān Rā'i Bhandārī's *Khulāsat-ut Tawārīkh* written in the first and last decades of the seventeenth century respectively. Both show an awareness that this crop was brought by Europeans.[71] It is clear that tobacco reached Bījāpūr by the end of the sixteenth century;[72] its

cultivation on an extensive scale was noticed in 1618 in Golconda.[73] As for northern India, Barbosa does not mention it among the agricultural produce of Gujarāt in the early decades of the sixteenth century.[74]

The real pioneer in introducing this crop to the Mughal Court was Asad Beg who brought a costly hubble-bubble with a *chilim* from Bījāpūr as a present for Akbar. He points out that he had not seen tobacco in north India. Actually, as Asad Beg says, tobacco was once presented to Akbar in the late sixteenth century by a physician who had brought it from the towns of Mecca and Medina, but Akbar did not show any interest in it at the time. The story of the Indian reaction to tobacco deserves to be told in full since it illustrates the thought-processes of scholars at the royal court.

Asad Beg writes that Akbar asked him to prepare the *chilim* which was promptly done. A moment before the Emperor started smoking, a physician requested him emphatically not to do so, but in order to please Asad Beg he smoked twice or thrice whereupon yet another physician anxiously pleaded with him against it. Akbar took the pipe (*na'i*) out of his mouth and asked Khān-i A'zam 'Azīz Koka to enjoy the fun, and he complied with the request. Afterwards, Akbar summoned the physician who had previously brought tobacco before him and asked him about the properties of the new crop. The physician observed that tobacco was not mentioned in *their* medical books but the Europeans had written much about it. Hakīm 'Alī, the celebrated royal physician, put forward the argument that since this drug (*dārū*) had not been tried (by them) nor had been touched upon by the scholars of the past its properties were unknown; therefore, he could not persuade himself to recommend it to His Majesty. Asad Beg, in an effort to refute Hakīm 'Alī's plea, argued that Europeans were observant people and had amongst them wise men who seldom committed mistakes. He added that tobacco smoking would not have been prevalent amongst their rulers and aristocrats unless they had conducted experiments to learn its properties. Asad Beg however admitted that one should study its good and bad effects before using it. Hakīm 'Alī insisted that they were not obliged to imitate the Europeans without experimenting themselves since the wise among them did not know of it. Upon which Asad Beg tried to

persuade him by saying that whenever a novelty was first accepted by a particular group of people and later became widespread, the wise among them must have known about its good and bad aspects. He thought that perhaps the utility of tobacco was unknown to Hakīm 'Alī. Further, he gave the example of China root (*chaub-i chīnī*), which, as he says, was not known in the past: it was a recent discovery and its uses for curing some diseases had come to light lately. The Emperor was much pleased with Asad Beg's arguments and he conceded that there was no ground to reject an innovation which had gained wide acceptance just because it had not been mentioned in *their* books. The whole controversy finally ended with the positive result that the Emperor did not interdict the use of tobacco though he did not himself smoke it again. Thus, tobacco triumphed in this trial: when Asad Beg distributed some of it as presents to a few nobles, it found astonishingly quick acceptance; so much so that others pestered him to procure some for them too. And soon the merchants took over its promotion, probably bringing it from the Deccan.[75]

While Akbar took a neutral position, Jahāngīr positively disapproved of its consumption, taking a cue from Shāh 'Abbās of Persia who prohibited it in his country. In 1617, Jahāngīr issued orders that no one should smoke it because it produced 'disturbance' in most 'temperaments'.[76] Sujān Rā'i says that Mughal officials at Lahore were so strict in the observance of this prohibition during his reign that they cut off the lips of some of the offenders. Despite such checks, we are ruefully told, the number of smokers increased steadily.[77] Indeed, it was accorded the first place among stimulants.[78]

Such a great demand for tobacco naturally resulted in the rapid extension of its cultivation. As early as 1613, the English factors recorded that this crop was grown on a large scale in the vicinity of Sūrat.[79] Terry speaks of its cultivation 'in abundance' in the Āgra and Sūrat regions.[80] By the reign of Shāh Jahān, tobacco was included in the revenue list of agricultural products of Sind.[81] It also spread to Sambhal and Bihār by the middle of the seventeenth century.[82] In the 1670s, a European traveller noticed both sugarcane and tobacco 'plentifully thriving' around Sūrat.[83]

In South India, we have already taken note of its cultivation

in Bījāpūr and Golconda during the first two decades of the seventeenth century. In the second half of the century, tobacco along with salt was counted among the 'principal revenue' earners of the King of Golconda.[84] The latter used to farm out land 100 miles around Masulipatam to state officials who had the sole monopoly of buying tobacco from the growers.[85] It is reported that tobacco was grown in such abundance in the neighbourhood of Burhānpūr that the cultivators in certain years neglected the (standing) crop and allowed half of it to decay.[86] These examples serve to substantiate the observation of a contemporary Indian historian that cultivators preferred to grow tobacco rather than other crops.[87]

Not surprisingly, therefore, a part of the plentiful produce was meant for export to other countries. In the early decades, it was exported to Mocha and Ārākān.[88] Again, in 1619, we find 155 *maunds* of tobacco being sent out from Sūrat to the Red Sea by the English factors; also Prince Khurram's junk was reported to have been loaded with tobacco for the same destination.[89] Thus, a new commodity was added to India's export list.

Of its quality, we are told in 1616–19 that (north) Indians were not able to cure and strengthen it as well as was done in the West Indies.[90] We cannot say whether Indian cultivators were able to improve their method in subsequent years, but this is certain that tobacco grown in Bījāpūr was of a very high quality,[91] and that of Golconda was considered to be the best in India by the end of the seventeenth century.[92]

That addiction to this exotic substance was quite widespread among every section of Indian society is amply borne out by contemporary records. Sujān Rā'i's observation that smoking found tremendous acceptance amongst the rich and poor, young and old,[93] finds its echo in what a European traveller wrote: 'The Natives in Generall smoke much tobacco, in soe much that children of 3 or 4 years of age frequently take it, and it is made as frequent amongst them as meat and drinke.'[94]

Describing the general food items of common Indians, another traveller noted that they take after their meals 'a pipe of tobacco' which 'contents them'.[95] The 'coolies' at Goa 'devoured more smoke than any thing else'.[96] The nobles of Golconda enjoyed smoking while lying in a palanquin; in fact, even while riding a horse, accompanied by two servants, one

holding an umbrella over his master's head, another carrying the tobacco-pipe.[97] We are told about the élite at Masulipatam:

> Their chiefest delight and pride is to be seen smoking tobacco cross-legged in a great chair at their doors, out of a long Brass-pipe adapted to a large crystal Hubble-bubble fixed in a Brass frame, their Menial Servants surrounding them.[98]

And the prize is taken by a Mughal official in the reign of Shāh Jahān who was discovered smoking in a palanquin just on the eve of a battle.[99]

While the *huqqa* was largely a possession of the rich, the 'poore' sort of Inhabitants' on the Coromandel coast used tobacco after an 'original manner', that is, by rolling the leaf up they 'light one end, and holdinge the other between theire lips, and smoke untill it is soe farre consumed as to warm theire lips, and then leave the end away'.[100] This was their 'bunko' which the Portuguese called 'Cheroota'.[101] On the other hand, aristocrats consumed a special preparation of perfumed tobacco;[102] even a Mughal princess is credited with having concocted a recipe for this.[103]

Pineapple (*ananās*), first introduced in territories under Portuguese rule,[104] also found quick acceptance in India. While Abul Fazl includes it in the list of the sweet fruits of Hindustan,[105] Jahāngīr in his memoirs is clear that it came from the harbour-towns held by the Portuguese.[106] The latter says that its young pineapple plants were brought from Portuguese settlements to Āgra where several thousands of them were grown in the *Gul Afshān* garden and other orchards. During the same period, it was also grown in Ghorāghāt in Bengal,[107] Gujarāt and Baglāna.[108] And by the 1760s, *ananās* of a high quality was available in Assam.[109] However, *ananās*, unlike tobacco, did not figure in the common man's food-list.[110]

Cashew-nut (*Anacardium occidentale*), a native of Brazil like the pineapple, was noticed in Portuguese settlements by the end of the sixteenth century.[111] Its cultivation did not spread to the north as fast as tobacco or pineapple: the *Ā'īn-i Akbarī* does not mention it at all. However, during the late seventeenth century it was found being grown on a large scale between Sūrat and Aurangābād.[112]

Next we come to potato (*Solanum tuberosum*), an item which

is not mentioned in the *Ā'īn*. George Watt is of the opinion that this vegetable was probably introduced into India from Spain, directly or indirectly, sometime between the end of the sixteenth and the beginning of the eighteenth century.[113] The first mention of the term 'potato' is met with in Terry's account of India (1612–19) in which he mentions that in the 'northernmost part of this empire' they have, among other crops, potato.[114] In the 1655 edition of his travels, Terry refers to a banquet given by Āsaf Khān to Sir Thomas Roe in November 1617 when 'potatoes excellently well dressed' were served. Foster suggests that Terry might be referring to sweet potatoes,[115] but he does not adduce any argument for this view. Āsaf Khān was fond of novel things, be they items of art,[116] technology[117] or even food. We have already recounted his banquet for Shāh Jahān when 'European style' dishes prepared by 'certain Franguinis' were served.[118] There is no reason to suppose that Āsaf Khān served sweet potato, or yams.[119]

When Barbosa visited Gujarāt in the early sixteenth century, he does not list potatoes among the agricultural products there.[120] After more than a century, Fryer noticed this crop being grown near Sūrat.[121] Earlier, in 1623, the English factors at Swally complained to their President at Sūrat that the potatoes sent to them were 'very small and poor'.[122] That the quality was bad perhaps indicates that it had been newly introduced in north India. Almost in the same period, it was noticed in Golconda too.[123] Later (1670s), Fryer writes that potatoes were the 'usual Banquet' of the people in Karnataka.[124]

A word about coconut. K. M. Panikkar is of the view that its cultivation was on a lower scale in Mālābār before the advent of the Portuguese. Since the latter were interested in it for obtaining coir for their ships, its cultivation was extended. Also, the seed nuts of a better and bigger type of coconut brought from African coasts were introduced into Kerala by the Portuguese. These coconuts are called *Keppal Thenga*, or coconuts from ships.[125]

The art of grafting was introduced into India most probably by the Portuguese.[126] Many varieties of mangoes were grown by them at Goa by grafting, Alphonso being one of these (see Careri, p. 202; Manucci, iii, p. 180; Bernier, p. 249; Burnell, p. 80).

Dress

We find a general indifference to European dress and costume. Occasional interest is in evidence but it is certain that this did not cross the frontiers of ordinary curiosity. When Mandelslo, the German traveller, came to Sūrat in the 1630s, he records that *bania* women in Sūrat 'were very desirous to see my cloaths, which I still wore after the German fashion . . .'[127] Earlier, in 1615, Muqarrab Khān asked for an English suit which was readily presented to him at Sūrat. When the English inquired into the motive of this request, they were told by their Indian broker that the Mughal noble desired the suit 'to shew unto his women' as a novelty.[128] We may infer that the harem's interest went no farther than this.

Nevertheless, it is interesting to note that Indian tailors at Sūrat (1642) had quickly learnt 'to worke after our English manner'.[129] By the end of the seventeenth century, as described above (Chap. I, p. 17), Indian tailors could make 'every Mode that prevails' among Europeans, both men and women, as if 'they had been an Indian fashion'.

But all this skill acquired by Indian tailors at Sūrat was meant primarily for their European clientele. They must have learnt the English craft largely by observation and imitation, and partly in association with European tailors. We know of at least one English tailor, William Appleton, who resided at Sūrat in the first half of the seventeenth century.[130]

As for stockings, it was noted that 'the Indians are at no charge, for they use neither stockings nor socks, but put their shoes on their naked feet'.[131] This remark is corroborated by portraits of the various individuals in the Mughal and other schools of painting. A contemporary European traveller offers the following explanation:

> The length of their Breaches which descend to their Heels, serve them instead of stockings; which is the reason that their language has no word for our stockings, so that they thrust their Feet always bare into their Shoes, which are very neatly Imbroider'd with gold, or silver, or silk flowers.[132]

However, Bernier holds a different view. He says:

> The heat is so intense in Hindustan that no one, not even the King, wears stockings; the only cover for the feet being babouches [*pāposh*], or slippers . . .[133]

Besides stockings, Indians did not accept wigs either,[134] nor did they consider their heads suitable for European hats. A hat was once presented to Jahāngīr by Muqarrab Khān, but it failed to elicit any response.[135]

In fact, the Europeans themselves realized in course of time the inconvenience of the cumbersome and heavy European costume, especially during the summer season in India.[136] The English and the Dutch attired themselves normally in accordance with the 'mode of the country', that is, India.[137] During the first half of the seventeenth century, we are told about the Englishmen at Āgra:

> Wee live after their countrie manner in matter of meate, drincke and apparell . . . our Habitt when wee go abroad is shash (turban) on our heads, a Doopatta or white lynnen scarf over our shoulders (this in summer and pummering in winter); then a fine lynnen coate, a girdle to binde about us, breeches and shooes, our swords and daggers by our sides . . .[138]

Thus, except for the breeches, there was little to distinguish the Englishmen at Āgra from Indians. At Goa, mestico women generally wore their traditional dress, 'the Portugall habitt seldome used by weomen, except few, and thatt on great festivall Daies, att their Marriages ettc.'[139] But the (Portuguese) men went 'after their country Manner, the Most part with great long wide stuffe breeches downe to their shoes, and others as they Doe in Portugall'.[140]

Considering these examples, we feel it hazardous to try to fix them in any 'theoretical' framework. At the most perhaps we can suggest that in territories under European political domination, European males tended to adorn themselves in their native attire, while the mestico females wore their traditional apparel. In places beyond the pale of such domination, Europeans perhaps publicly adopted Indian sartorial habits to some degree. In the latter situation, there was scarcely any motivation for the generality of the Indians to consider the slightest acceptance of European dress.

Social manners, habits and etiquette

About eating habits, foreign travellers are one in saying that the 'table is spread on the ground without Napkins or table

cloth'.[141] When Mundy visited the ruler of Ikkeri in South India, he found that at the 'Kingly banquet' there were 'neither table nor stooles, trencher nor napkin, knives nor spoones'.[142] Again, at the banquet given by Āsaf Khān to Shāh Jahān in 1641, Manrique noted the absence of napkins.[143] Indeed, these accounts tell us that the lack of use for the items mentioned above was by and large a universal Asian way of life, be it in the Maldives,[144] Achin[145] or Persia.[146] Even here, we find the English at Āgra imitating the Indian way of eating. Mundy says:

> Our meat for the most part after the custome of this place, sitting on the ground att our meate or discourse . . . The roomes in generall covered with carpetts with great round, high cushions to leane on (this as well in publique as in private) . . .[147]

For Sūrat, we are informed:

> The factors when they eat at Home do it after the English manner, but abroad they imitate the customs of the East in lying round the Banquet upon the Persian carpets which are spread upon the ground . . .[148]

If Europeans imitated Indians in public in this respect, there was again little motivation for the latter to ape the former. Moreover, Indians perhaps could not have exchanged the 'comfort' derived from sitting on the ground for that from chairs and tables, the latter not being accepted as a part of the usual household furniture. When Sir Thomas Roe went to see Jahāngīr, he was asked to sit on the carpet. Roe told him that he could not stoop (because of his western clothes), upon which Jahāngīr sent for chairs.[149] This example only indicates that chairs were available, at any rate, for special occasions in royal households, and perhaps in noblemen's residences also. But ordinarily chairs were never meant for daily use.[150] However, Fryer describes the houses of rich Muslims as follows:

> Their furniture is moveable, as Rich carpets to sit on the floor, and the rich cushions behind them, without any chairs within doors, unless large elbow chairs when they sit at their Doors smoking in State.[151]

But the common people could not think of such large elbow chairs. Thus Bowrey:

> They seldome or never accustome themselves to walkinge for recreations sake, as wee Europeans doe, but if they hold any conversation it

must be sittinge, and not upon chairs, stools, or benches, but upon carpets or Matts spread on the ground and on them they sit crosse-legged with much facilitie.[152]

The European form of salutation, that is, uncovering the head,[153] the Indians cared little for, except the Armenians in India who moved their turbans as 'we our Hats'.[154] Similarly, to salute a woman 'with a kiss' or walk together in a garden with her was considered to be ill-conceived.[155]

And to make water in a standing position was taken to be a shameful act: Indians remarked that 'such a one pisses like a Dog [who is held unclean] standing'.[156]

And, finally, we are told that it was not the fashion among the Indians to undress before going to bed. They lay in the same clothes that they had worn during the day.[157]

CHAPTER V

EPILOGUE

In the foregoing chapters we have reproduced and examined a mass of material. We shall now recapitulate the essential points and endeavour to set them out in some order. We shall also add a few considerations which did not find a place earlier.

It is reasonably clear that regionwise contacts between Indians and Europeans along the coastal regions were, quite understandably, not only the first to occur, but also developed into regular, permanent and durable contacts on a scale substantially larger than was the case in inland regions. Further, it was along the coastal regions first that a few 'pockets' came under direct European domination with the consequent radiation of influence in the surrounding areas. Besides these territorial units, other places—ports and inland towns—where Europeans were permitted to establish their factories, etc. also had the opportunity of reasonably continuous links with them. Large towns of administrative and commercial importance could boast of such intercourse, but on a modest scale. Coming to the countryside, we find the scale of contacts being reduced greatly in comparison to other regions; nevertheless, the large number of townships and *sarā'is* along well-known trade-routes were exposed to Europeans although the contacts developed there were occasional, casual and short-lived. Thus, in terms of duration and frequency of contact, most of the European settlements of different types on the coastal regions could easily be accorded the first rank, other areas trailing behind in varying degrees.

The channels, occasions and sources of contacts were numerous: administrative, commercial and intellectual, curiosity in exotic articles, recruitment to various jobs in both directions, proselytizing activities, intermarriage, etc. These channels implicitly indicate that Europeans met several social groups, that is, the upper ruling strata comprising rulers, princes, nobles;

administrators, especially at the ports and custom-houses; scholars, merchants, brokers, etc. connected with trade; artisans; soldiers and nondescript Indians.

But it must be pointed out that the nature and degree of contact with each social group was not similar or of equal magnitude. If the sovereigns, princes and a few nobles were interested, for example, in European painting, the members of the mercantile group fostered an obviously different link. The Mughal emperors might arrange religious debates in their courts, but the pattern of contact in the case of artisans was a different proposition. As for duration and scale, it seems that the mercantile group and nondescript Indians working under Europeans in various capacities had a more extensive and regular contact than the rest. On a relatively lesser plane, administrators at the lower end of the hierarchy, artisans and Indian artillery-men also deserve to be singled out from the point of view of meaningful contact.

Turning to an assessment of European impact, let us first take up technology. Our study cautions us against evolving any single formula invariably operative in all the sectors of technology; or for that matter, any specific sector composed essentially of several closely interlinked areas of skills does not permit us any absolute generalization. In other words, any one of the three categories of response—positive (acceptance), negative (rejection) and neutral (indifference)—cannot be seen as applicable to all the areas of technology. Clocks and watches, for example, were rejected outright, while response to artillery was positive; or an item like the printing press got a lukewarm reception. Again, in the sector of shipbuilding, Indian response to the use of iron nails, iron anchors, capstans, etc. was quite positive, but caulking or casks were rejected. On the other hand, Indians for a long time showed indifference to the European craft of rope and cordage making, and the use of pumps for bailing out water. It was only to the second half of the seventeenth century that a feeble interest in these two items can be traced.

Further, while considering a single European article, it is important to note that response to its *use* might be positive without arousing an interest in its technology, that is, the process of manufacture. Thus we have looking-glasses, window-

panes, pumps, pistols, shells and grenades, etc. which were welcomed but no attempt was made by Indians to learn the European technique of manufacturing them.

Broadly speaking, there seems to be a positive response to those sectors of European technology which threatened Indian interests most; while those that apparently did not pose immediate danger were neglected or passed over, if not in use, then technologically. Thus, shipbuilding and artillery engaged the attention of Indians since both posed a real threat to them. In contrast, an item of land transport like the European coach drawn by horses in no way represented a threat warranting the replacement of the indigenous cart yoked to bullocks.

But that is not all. There could be a variety of reasons for the rejection of and indifference to particular items of technology. As we have shown, casks and caulking were rejected by Indian seamen not only because they inflated the cost of a vessel, but also because their supremacy over indigenous *alternatives* was never an acknowledged fact; even the Europeans in India recommended the latter. Similarly, Indians did not evince a keen desire to learn the European rope-making craft although their ropes caused some inconvenience to them. This inconvenience was, however, counterbalanced by the easy availability of raw material and also the low cost of production.

In other cases, the Europeans in India themselves did not set an example in using certain items, namely, window-panes, coal, the coach, etc. on a scale that would inspire Indians to emulate them. Instead they usually used oyster-shells in place of panes, wood for coal and Indian carts instead of their own horse-drawn coaches. Thus, for certain items, there was no 'demonstration' effect.

Moreover, non-availability of European experts in some sectors, for example glass technology, inhibited any noteworthy development notwithstanding the fact that at least a few of these articles came into the possession of Indians either through gift or purchase. Again, there was scarcely any opportunity for Indians to learn European methods of mining since, with the exception of the pump for use on ships, no equipment was brought to India.

Reviewing some of the instances of rejection or indifference narrated above, it is pertinent to assess the response of two

classes of Indian society—the merchants and the artisans—who were closely associated with the production-process. We should, then, first ask why Indian merchants did not undertake the manufacture of some of the European articles. This may be answered only in a larger framework, that is, the degree of penetration of merchant-capital into the Indian production system. Elsewhere we have shown the feeble hold of merchant-capital over the production-process during the seventeenth century, and its failure to help develop commodity-producing manufactories under its superior capitalist direction.[1] But this failure did not spring from lack of capital.[2] The investment behaviour of Indian merchants, that is, the diversion of their wealth towards the commercial sector rather than investment in the production-process directly, was guided more by the profitability factor than dictated by the absence of risk-taking entrepreneurship. Thus, in a situation where even the indigenous crafts were not brought under direct supervision of Indian merchants, it is unfair to expect them to turn their attention to foreign goods. Moreover, why should they have invested capital in producing articles, say, looking-glasses or pumps, when they knew there was no substantial market for them? To say that they should have manoeuvred to create a potential market for such goods would be to project a modern practice into the distant past. If merchants could derive an extraordinarily high rate of profit—40 to 100 per cent—through buying and selling traditional commodities,[3] there was hardly any economic justification for them to plunge into the production of items whose salability was extremely restricted. We must point out here that even Europeans did not take to producing such articles in India, and wisely so.

As for the artisans, it must be remembered that, unlike the merchants, their contact with Europeans was usually not of a nature that allowed them to acquaint themselves with European technology with a few exceptions cited earlier. Even in sectors where such possiblities really existed—for example, shipbuilding—artisans learnt new methods only to meet the demand of ship-owners. As was the case with merchants, an absence of reasonable demand for other types of European technology certainly discouraged them from acquiring knowledge of new techniques on their own. Again, the need for relatively heavy

investment in some sectors proved a basic handicap. Here it must be recalled that Indian artisans were fully equipped to imbibe new technology with a 'pattern' or a 'model' before them—indeed their skill at imitation was a unique asset.

These considerations urge us to focus on a category of consumers whom we should expect to be interested in some European manufactures. The upper class in India, comprising sovereigns, princes and nobles, was in a position to foster the production of European articles in their *kārkhānas* where a variety of articles were already being manufactured for direct consumption by them. We may ask why they did not succeed in manufacturing some luxury items like looking-glasses or window-panes in their *kārkhānas*. Was it because they could afford to pay for these costly articles, or did the procurement of European expertise in this sector pose a problem? Take clocks and watches. It is clear that the principal source for members of this class of these goods was by way of gift. In this connection, Ovington is not justified in implicitly denigrating Indian artisans with the jibe that the Chinese were able to understand the mechanism of the clock while Indians never attempted to. Indian artisans never attempted it because they were not asked by their patrons and clients to do so: Jahāngīr asked carpenters to prepare European coaches after a model, or artists to copy European paintings, but why could he not have asked the artisans to copy the basic mechanism of clocks? A matter of taste perhaps, or whim?

Let us for a while compare the situation in Persia, Turkey and China with reference to clocks and watches. The Persian ruling class, like the Indian, did not show much interest in these articles even though an English clockmaker put up a public-clock under Shāh 'Abbās (1587–1629) in the market of Isfahān, and a Swissman produced a very small watch for the king.[4] But in Turkey, we are told, the Sultāns employed French clock-makers in the sixteenth century. Later, a colony of watchmakers from Geneva settled in Galata—'the suburb and foreign quarter of Istanbul'—under official patronage. In fact, in Turkey there was a large market for English watches. We find an Arab national in Turkey extremely interested in the European weight-driven and spring-driven clocks, having observed them in his patron's house.[5] As for China, K'ang-hsi, the Chinese

Emperor, noted with delight in his memoirs in the second half of the seventeenth century:

> And when the Emperor Shun-chih got a small chiming clock in 1653, he kept it always near him; but now we have learned to balance the springs and to adjust the chimes and finally to make the whole clock, so that my children can have ten chiming clocks each to play with, if they want them.[6]

It is true that in both the Turkish and Chinese cases the time-reckoning system was more or less akin to that of Europe. But the Indian élite, unlike the Japanese, did not try to modify the mechanical clocks to suit their own system. Jahāngīr, the Mughal Emperor, missed the one vital opportunity narrated above. Anyway, want of 'patronage' alone does not explain the matter.

One also could well ask why yet another section of Indian society, that is, scholars and 'scientists' who were for the most part advantageously situated through liberal grants from the upper class, did not evince any active interest, say, in the printing press—something which should have concerned them most. Ovington's guess that the opposition of calligraphers inhibited the diffusion of the printing press among Indians should be unceremoniously rejected. There is not an iota of evidence to suggest resistance from calligraphers issuing from a fear of technological unemployment, or that it was ever put up to Jahāngīr who showed a flickering interest, or to Bhīmjī Parak who seriously set himself to putting one up. In fact, Bhīmjī's press never got a chance to develop so that the calligraphers could see its adverse implications for themselves; for that matter, Indian calligraphers did nothing to oppose it when it started serving Indians in their own languages in the eighteenth century.

What is most striking, however, is the fact that Indians never learnt even the block-printing of books from the Chinese culture-area in spite of the long cultural and trade links that existed; nor did they think of developing it on their own by getting the idea from the seals they used and, later, from textile block-printing.

Incidentally, it has been suggested that Islam stood as a barrier to printing and that the rejection of printing was a

common phenomenon all over the Islamic world.[7] It is pointed out that Rashīd-ud dīn, the author of *Jāmia'-ut Tawārīkh* and the *wazīr* of Ghazan, the I'l-Khānid ruler (A.D. 1295–1306) of Persia, took notice of Chinese block-printing in his above-mentioned work, but he did not contemplate having his celebrated work *printed*: instead, he left a will that each year two full copies of all his works should be made by *hand*, one in Arabic and one in Persian, until gradually there should be a complete copy in the mosque of every large city of the Islamic world.[8] What is surprising is that Rashīd-ud dīn was a witness to the short-lived issue of paper money (A.D. 1294) during the reign of Gaikhatu Khān (1291–5), the predecessor of Ghazan. This suggests that there were artisans in the Chinese quarters in Tabriz who knew the art of block-printing.[9] And yet, it could not develop in Persia. The only exception in the Islamic world was Egypt where in 1880 some fifty scraps of printed paper were discovered, Arabic in language and Islamic in content, many of them passages from the Qur'ān, the dating of which has been fixed between A.D. 900 and 1350, after which the evidence for block-printing ceases.[10] T. F. Carter observes:

> It is strange that such a literary, and such a religious, people as the Arabs refused to use this vehicle for the spreading abroad of religious thought. Paper they found in Central Asia—and with almost incredible quickness it displaced all other writing materials from Samarkand to Spain. But not so with printing.[11]

The learned author finds himself unable to explain this lack of interest except by attributing it to 'conservatism'[12] and 'a peculiar prejudice of the learned'.[13] When a Hungarian in 1727 desired to erect a (type) printing press at Constantinople, the '*ulema* under Sultān Ahmad III protested that it was against the religion and honour of Islam to allow the printing of the Qur'ān; therefore, permission for the press was given with the condition that the Qur'ān would not be printed.[14]

At any rate, we submit that it is inappropriate to attempt to examine the *Indian case* as part of the general Islamic phenomenon. Nevertheless, we are hard put to it to explain the partial indifference to printing during the seventeenth century in India. For the present, we may be allowed to offer two lines of approach for further inquiry.

First, a study of printing in Europe reveals that in the begin-

ning the growth of this art owed much to the *joint* efforts of the members of three social groups, viz. the merchant-entrepreneur, the scholar and the artist-engraver. Could the Indian social *milieu* of that period have provided such an 'auspicious' meeting-ground?

Secondly, could the apparently *enormous number* of the calligraphers have dissuaded the 'patrons' of learning and scholarship from thinking of an alternative media for the duplication of written material? Coupled with this, we must also investigate the dimensions of literacy and the magnitude of demand for books in India.

Apart from the assortment of considerations offered for explaining acceptance, rejection or indifference, we may add that in certain instances European articles in their original form did not fit in with the then Indian scheme of things. The best illustration of this sort is mechanical clocks, which were useless unless modified to suit the Indian way of reckoning time in that period.

Emerging from the technological mesh, let us now turn our attention to lighter aspects. Taking up painting, it is proper to point out that this genre of art was predominantly the cultural possession of the upper class—at any rate, that is the dimension of our investigation. We have already noted that contact with and exposure to European paintings was confined to the élite group of painters who worked under the patronage of the ruling clique. Naturally, then, the artist's freedom was restricted by the outlook, tastes and whims of his employer or patron. Comparatively speaking, the painters at the Mughal court appear to have been more fortunate in having liberal masters with pronounced artistic predilections than those serving at regional courts in the Deccan or Rajasthan. Another factor to be taken into account is that the painters at the Mughal court had a longer and more meaningful contact with European specimens of painting than the artists at other courts. It is no wonder, then, that the Mughal school of painting stands far above the others in its positive response to European tenets of art.

However, there were a few areas that failed to elicit active interest: one of these being painting in oil. Roe's statement about Jahāngīr's dislike for this technique may be valid for that

Emperor's period only: there is no record pertaining to Shāh Jahān or the Deccani rulers expressing a similar view. A plausible explanation for this universal indifference to colour preparation with oil may well be that oil-painting was perhaps not compatible with the Indian artist's medium. Again, the scientific delineation of muscular projections of human or animal figures was beyond the grasp of Indian artists since they did not possess the experience of observing dissected bodies with trained eyes. The indifference shown towards the frontal depiction of faces, and also to the European practice of hanging paintings on walls, remains largely inexplicable.

The tantalizingly scanty account of music will hardly admit of any worthwhile analysis. The incident at Jahāngīr's court may perhaps indicate that somewhat as in the case of painting, music too was a matter of the patrons' tastes. However, the dichotomy between the European and Indian musical systems in terms of harmony and melody could not have created a favourable climate for the acceptance of the former.

There was not much chance of the acceptance of European architecture except occasionally in those coastal areas which were under direct European control, and where large-scale conversion had taken place among the local population. Perhaps some of the latter group from the higher castes might have imitated European styles in their zeal to identify themselves more closely with the foreign rulers. This could have been possible because of the experience gained by Indian masons who were employed by Europeans to build houses of different types on European models under their supervision. Window-panes were expensive, and therefore their use was greatly limited: in fact, the Indian *alternative* of oyster-shells was much cheaper and more beautiful, and was used quite extensively even by Europeans in India. Again, a heating device like the chimney was not of much utility in a country where most parts remained under the hot weather spell for almost three-quarters of a year. After all, how many buildings erected or used by Europeans in India in that period could boast of a chimney?

Among the European languages, Portuguese, for historical reasons, enjoyed a wider popularity among Indians than any other, especially along the Western coast. The English language came next, but on a very subdued note.

The heavy and cumbersome European apparel did not lure Indians: wigs, stockings and hats were given a wide berth. A few mesticos and converts might have patronized exotic apparel, but the bulk of the population responded negatively.

Tobacco and items of food like pineapples, cashew-nuts and European desserts were accorded an extraordinary welcome. The debate over tobacco at Akbar's court was purely an academic exercise; nor was Jahāngīr's interdiction founded on theological grounds. In contrast, leavened bread or loaf bread received a negative response. Its acceptance would have meant a big dislocation in the traditional method of preparing bread, calling forth changes at various levels, thereby inviting some disruption of routine in exchange for *uncertain* gains.

The Indian custom of eating food while sitting on the ground, or eating with the fingers, was a matter of *motor* habits; a changeover to tables and chairs, or spoons and forks, was not worth the trouble. Nor, for that matter, did urinating in standing posture, or not washing with water after evacuation, possess any physiological or hygienic advantages, or reflect the values of a superior culture worthy of imitation.

Any innovation at its birth is likely to generate apprehension, and invite criticism and opposition in varying degrees from those social groups in a society which are likely to be adversely affected for some time or permanently. The history of technology in Western societies adequately establishes this trend. The following examples will serve our purpose:[15]

(*a*) Mechanical looms were forbidden by the Danzig City Council in 1586. Later, in 1685, an Imperial edict banned all mechanical looms.

(*b*) In England, the use of 'gig mills' for teasing cloth was prohibited by an Act of Parliament in 1551.

(*c*) Pressing cloth under heat was banned everywhere in Europe in the late Middle Ages.

(*d*) Coin-presses were opposed by minters for a long time.

(*e*) Mechanical knitting (stocking-frame) met regular resistance from hand-knitters so that the machine could make only slow headway in the seventeenth century.

(*f*) The printing-press was opposed in England for some time.

(*g*) The case of the Luddites violently opposing the introduc-

tion of power-driven machinery in England during the early decades of the nineteenth century is well known.

No scholar has ventured to conclude on the basis of these examples that European society was conservative, tradition-bound or allergic to innovation. (We are not concerned here with the 'inventiveness' of a society: for that matter, not all innovations in history originated in one society alone. Diffusion, transmission and exchange of ideas and objects have been the most significant features of the history of science and technology.) Thus, within the same social milieu, an innovation may be advocated and opposed by different classes or social groups in line with their interests. Resistance, therefore, must be expected to be sharper when an idea or object from one culture-area moves to another. As Arthur Lewis aptly put it, '. . . not all new ideas are appropriate, however useful they may be in some other country'.[16] Considering the case of India in this light, we are afforded some surprises.

That there was no lack of interest in exotic things has been extensively shown in the foregoing chapters. Even prior to the arrival of Europeans, foreign technology, namely the spinning-wheel, paper, the stirrup, the Persian wheel, etc., introduced by the Turks into India, was warmly and quickly welcomed.[17] It is indeed surprising that there is scarcely any documented evidence for resistance to these articles during the thirteenth and fourteenth centuries. It may however be argued that objects and ideas cultivated by the politically dominant group are likely to be adopted by others more freely and smoothly than otherwise.

Again, the caste system, an obsession with Max Weber and his devotees, has been singled out as the pre-eminent culprit. But it does not follow from our present inquiry that the caste system had an inhibiting influence; in fact, we have not so far been able to trace any evidence relating to our theme for any basic role played by caste rules *per se* in hindering technological adaptability.[18] This is not the proper place to discuss the caste system in depth, yet the following points need to be emphasized. *Varna* and *jātī* should not be identified as a single impulse. *Varna* is a regular, permanent system based on the fourfold division, while *jātī* is an irregular process whose splitting and sub-

splitting with a myriad of rituals, rites, taboos, and principles of mutual interrelationship for adjustment of status and changes in craft specialization thoughout its history have violated nearly all the theories and norms laid down by the Brahmanical corpus of laws. The Mughal administration, at times, played a part in reinforcing at least one aspect of this process, that is, occupational mobility.[19] Once occupational mobility is admitted, theoretical rigidity becomes inoperative.

A comparison between response to technology and that to culture is interesting. Our inquiry gives the impression that positive response to culture is, by and large, slower than that to technology.

Indeed, our inquiry does not uncover built-in resistance to non-traditional products of technology, but *as long as there was an 'alternative' or 'appropriate' indigenous technology which could serve the needs of Indians to a reasonable degree, the European counterpart was understandably passed over.*

To sum up, Indian response to European technology and culture during the sixteenth and seventeenth centuries was scrupulously *selective* in its nature, depending on convenience, utility, exigencies or other material and pragmatic considerations; also, the negative response was never a result of plain xenophobia, racial aversion, ingrained conservatism, or the pejoratively referred to 'oriental' resistance to innovation.

APPENDIX A

European Paintings Brought to India

The selective list of paintings which follows is largely based on original European specimens brought to India, copies and adaptations of the originals executed by the Indian artists, and contemporary sources.

(i)

(a) 'Holy Family': Kuhnel and Goetz, Pl. 41; Ivanova *et al.*, Pl. 52.
(b) 'Annunciation': V & A, IM 7–1913; BM (OA) 1920 9–17 013(21).
(c) 'Cleaning the Inn of Bethlehem': V & A, IS 170–1950.
(d) 'Nativity': V & A, D. 402–1885; Arnold and Wilkinson, iii, Pl. 82; Coomaraswamy, pt vi, Pl. lxxxiii.
(e) 'Presentation to the Temple': BM (OA) 1920 9–17 036; I.O., Johnson, 14–3; Arnold and Wilkinson, iii, Pl. 83.
(f) 'Adoration (and Donors)': V & A, D. 402–1885; Hajek, *Indian Miniatures of the Moghul School*, Pl. 31.
(g) 'Christ in Wilderness': V & A, Clive Album, f. 14a.
(h) 'Christ's Entry into Jerusalem': BM (OA) 1965 7–24 05.
(i) 'The Last Supper': V & A, Clive Album, f. 19b. Also see I.O., Johnson, 6–6.
(j) 'Scoffing': BM (OA) 1974 6–17 021(28); Bharat Kala Bhavan, Varanasi, Accession no. 10439.
(k) 'Crucifixion': Ivanova *et al.*, Pl. 21 (upper part, central figure). Chandramani Singh, 'European Themes in Early Mughal Miniatures', *Chhavi*, Golden Jubilee Volume, Bharat Kala Bhavan, 1971, fig. 594.
(l) 'Descent from the Cross': V & A, IS 133(79)–1964; BM (OA) 1920 9–17 0276(B).
(m) 'The Last Judgement and Resurrection': V. Menkes, *Paintings from the Muslim Courts of India*, fig. 94a.

(ii)

(a) 'Madonna by the Tree': I.O., Dārā Shukoh Album, f. 42 verso; Kuhnel and Goetz, Pl. 42; Mario Bussagli, *Indian Miniatures*, Pl. 31.

(b) 'Madonna on the Bed': Coomaraswamy, pt vi, Pl. lxxxi.
(c) 'Madonna with a Rose': I.O., Johnson, 14–2.
(d) 'Madonna with a Snake': I.O., Johnson, 14–9.
(e) 'Madonna on a Crescent': I.O., Johnson, 14–10.
(f) 'Madonna on the Rock': Ivanova *et al.*, Pl. 54.
(g) 'Madonna Feeding Infant Jesus': BM (OA) 1942 1–24 02.

(iii)

(a) 'Mars': *Voyage of Downton*, p. 8.
(b) 'Venus': ibid., p. 8.
(c) 'Venus and Cupid Actes': *Voyage of Thomas Best*, p. 244.
(d) 'Diana': Roe, p. 488; *EF*, 1618–21, pp. 38, 54.
(e) 'Judgement of Paris': Ivanova *et al.*, Pl. 53 (left part); *Voyage of Downton*, p. 8.
(f) 'Neptune': Chandramani Singh, Pl. 35.
(g) 'Plato and His Organ': *Khamsa*, BM Or. 12208, f. 298a.

(iv)

(a) 'A page with four tinted Mughal Drawings based on European Engravings': V & A, Small Clive Album, f. 2a.
(b) 'Portrait of a Portuguese Gentleman': Coomaraswamy, Pl. xxvi.
(c) 'A European': V & A, IM 9–1913.
(d) 'A European Couple': Dārā Shukoh Album, f. 74 recto.
(e) 'European Lady Feeding Her Dog': Johnson, 14–7.
(f) 'European Holding a Wine Cup': ibid., 16–8.
(g) 'European Reading a Book with Attendants Around': ibid., 16–6.
(h) 'A European Drinking Party': V & A, D. 399–1885.
(i) 'A Doctor of Law Facing a Storm in a Landscape': ibid., IS 218–1952.
(j) 'Four European Ladies Feasting by the Bank of a River': BM (OA) 1928 8–15 05.
(k) 'A European Couple in a Garden': BM (OA) 1936 6–13 01.
(l) 'An Old Man Offering Money to a Young Woman': Milo C. Beach, 'The Gulshan Album etc.', fig. 10a.

APPENDIX B

Memorandum by Captain Downton

The coppy of a note given in by Muccrob Canne of such thinges as hee desireth to bee furnished by the next ships that come out of England:

a. Two compleate armours wroughtte, but lightte and easy to wear.
b. Crooked swordes, broad; hard to be gotten, for they try them with their knee and if they stand, in no request.
c. Knives of the best, large, long and thine, to bowe almost rouind and com straight againe of themsealves.
d. Satten of red, yellowe, greene, tawny.
e. Velvett of the best, of red, yellowe, black, greene.
f. All manner of toyes that may contentt the Kinge.
g. Broadcloth of the finest, that will not staine, of yellowe, red and greene.
h. All manner of toyes for women.
i. Pictures in cloth, not in wood.
k. Perfumed lether.
l. Cloth of Arras, wrought with pictures.
m. The greatest looking-glasse that maye be gotte.
n./o. Any figures of beastes, birdes, or other similes made of glas (se), of hard plaster, of silver, brasse, wood, iron, stone, or ivorye.
p. Perfumed sweet bages, imbrodered with gold.
q. Rich cabinettes with a glass, imbrodred.
r. Rich shag of red cullor.
s. Mastiffes, greyhoundes, spaniells, and little doges, three of each.
t. Large Muscovia hides.
v. Vellem and parchmentte, good store.

(*The Voyage of Nicholas Downton*, p. 187; Also see *Letters Received*, II, p. 173)

APPENDIX C

Additional Notes on Technology

Explaining the method of manufacturing a portable gun devised by Fathullāh Shīrāzī in the 1680s at Akbar's court, Alvi and Rahman suggest that it was made up of several detachable parts *screwed* one into the other. But they do not say anything on the type of screw used in this item for the simple reason that no evidence is forthcoming from the sources cited by them.[1] However, Thévenot, writing in the second half of the seventeenth century, compared the Indian screw with the European one thus:

> The Indians of Dehly cannot make a Screw as our Locksmiths do; all they do, is to fasten to each of the two pieces that are to enter into one another, some Iron, copper, or silver wire, turned Screw-wise, without any other art than of souldering the wire to the pieces; and in opening them, they turn the screws from the left hand to the right, contrari-wise to ours, which are turned from the right to the left.[2]

Thus, the European type of screw with grooves cut by a lathe did not leave an impression on the Indian smiths even by the late seventeenth century.[3] A specimen of an Indian metallic incense-burner with screw, answering to Thévenot's description, is lodged in the Science Museum, London. The burner has not been assigned any date, but it might belong to the late eighteenth or early nineteenth century. In Persia too, metal pieces were joined by soldering, and not by screws as in Europe.[4]

European saws must have come to India and been used here by Europeans, although we have been able to find only one reference to English saws being sent to India, in 1676.[5] Later, in 1689, Ovington noted:

> For as their Kingdoms, so are their customs in these kingdoms quite opposite in many things to ours. The Teeth of their Saws, for instance, are made quite contrary to ours; their Locks are fashion'd and open quite different ways . . .[6]

During the second half of the seventeenth century, Olafsson described the working of bellows in South India as below:

> Their bellows are not like ours, being without ribs, and always full of wind. They have no wooden end, but a long iron pipe, which is fixed and nailed on the forepart of the bellows. They . . . set to blowing the bellows in kneeling posture. Now they do not blow them as we do, but seize the middle of the bellows and press and pinch them; and they draw at once.[7]

Tavernier refers to the use of *lead pencils* covered with wood at Goa.[8] Perhaps its use was not widespread in the country, but the Indians had started using such pencils (*qalam-i surb*) in the second half of the seventeenth century which is confirmed by an incident at Aurangzeb's court (30th regnal year).[8a] That this article was a European innovation is attested to by the author of *Mir'āt-al istilāh* (1748), a Persian glossary, who calls it *qalam-i faringī* (European 'pen').[8b] The author adds that people thought it was made of antimony (*sang-i surma*) which he dismissed as incorrect. However, the account in this glossary leaves the impression that *lead pencils* were not made in India even during the second half of the eighteenth century.

In another instance, we are told that the Indians can 'imitate a little the English manner of Book-binding'.[9]

Negative response to the first three articles may be partially explained by the fact that Indians possessed *alternative* devices of their own, which, except for the screw, were by no means inferior to the European ones functionally. Secondly, the extent of exposure to European screws, bellows and saws appears to have been extremely restricted. It is doubtful whether Europeans brought or manufactured European bellows in India. On the other hand, book-binding in the English manner was learnt by the Indian artisans, encouraged by their high-placed patrons who obtained European books as gifts for their library.

Did Indians learn from European metallurgy? Let us take the example of cannon-making in India. Bābur, describing the founding of a cannon in 1526 by Ustād 'Alī Qulī, says:

> Round the mortar-mould he had had eight furnaces made in which were the molten materials. From below each furnace a channel went direct to the the mould. When he opened the furnace-holes on our arrival, the molten metal poured like water through all these channels into the mould.[10]

That this process continued down to the second half of the seventeenth century is attested to by Thévenot:

> They have cannons also in their towns, but since they melt the metal in diverse furnaces, so that some of it must needs be better melted than others when they mingle all together, their cannons is good for nothing.[11]

Again, late in the seventeenth century, Burnell noted about cannons at Hugli:

> . . . of the country make, being almost as thick at the bore as it is at the breach, compacted of a great number of iron hoops for the bore, then laid round with iron bars for the length of the gun, and lastly those bound over or cas'd with other hoops of the same metal all worked together at the forge, like the iron bars in a large anchor, they being excellent artists at it.[12]

The examples of gun-making by Europeans working for Indians described in Chapter II do not clarify whether the European manner was being used, and if so, whether Indians were exposed to it.

A reference may be made here to an item of European technology which was not brought to India in its physical form, but the *idea* did get a chance of being aired before Emperor Jahāngīr, perhaps indirectly. Richard Steel, an Englishman, proposed a scheme for the construction of a waterworks at Āgra by which the water of the Jumna would be conveyed through lead pipes to the different parts of the town. Steel had in his mind the example of London where the water from the Thames was carried through pipes at the close of the sixteenth century. This proposal was pooh-poohed by Sir Thomas Roe, and ultimately it failed to elicit any response from the Mughal Court.[13]

Another interesting *idea* was proposed by the English factors at Sūrat in 1703. They wanted to employ 'some contrivance for raising water by a pump out of the well for the service of the Factory for lessening the charge of oxen imployed for said use'.[14] Unfortunately, we do not know whether this proposal ever took shape.

Postscript. European snaphaunces were available in India in the early seventeenth century. Joseph Salbancke testified to this when he wrote in 1609 about Burhānpūr: 'This citie standeth in eight and twenty degrees, where Muskets, Snaphaunces, Pistols, Petronels, and Swords are very saleable' (*Purchas His Pilgrimes*, iii, p. 83). There is good reason to believe therefore that European snaphaunces were being brought to India long before 1609, creating a market for themselves. If, as we have suggested on p. 52, Akbar's arsenal produced handguns fitted with snaphaunce locks, Akbar's gunsmiths were in all probability familiar with European snaphaunces and used them as models.

APPENDIX D

Launching a Ship for Sheathing
(Ref. Ch. II, Capstan)

I have seen a ship, (belonginge to the Kinge of Golcondah) a ship of great burthen, built for the trade to Mocho in the Red Sea, and after 2 voyadges thither, she was halled upon the Westerne side of this River a little above the towne, to the intent they might sheath and repaire her. She cold not be lesse (in may judgement) then 1000 tunne in burthen and they halled her up by strength of men with good purchase as follows:

They prepared 2 very substantial timbers, of 20 foot longe each, and 20 or 24 inches in thicknesse, upon which they Erected a cradle fittinge for the bildge of her, the 2 main timbers beinge place at that distance that the cradle beinge put under her, the foremost was 8 or 10 foot abaft the scarfe of her stemme, the other as much before the heele of her sternepost, with girdlines from the said cradle to her ports or Scopeboards (Scuppers); to the dogs were fitted good straps and fourefold tackles, the falls of 15 or 16 inch coyre cable, the which are brought to too [*sic*] very substantiall crabbs, placed a little above the height they purpose to heave the ship to, and heave first at one end then at the other 5 or 6 foot at a time, and soe on untill she is high Enough, the Doggs runinge upon good rowlers, as in manner followinge:

A. One of the Doggs, vīzt the aftermost.
B. The Square pins (or fids).
C. The Rowlers.
D. The ships Keele.
E. The craddle.
F. The bedds and quoynes to support the cradle.
G. The ships bildge.
H. The Ends of the Yards or Powles from End to End.
I. Girdlines from the cradle upwards.
K. Great strapps sweepinge round the dogs.
L. The Great blocks.
M. The Tackle falls
N. The crabbe.
O. The Barrs

(Thomas Bowrey, *A Geographical Account of Countries Round the Bay of Bengal, 1669 to 1679*, ed. R. C. Temple, Cambridge, 1905, pp. 103–4)

APPENDIX E

Cartography

The study of geography in Medieval India appears to be largely literary—descriptive rather than practical or cartographic. Witness, for example, the *Ā'īn-i Akbarī* in which the account of the *ṣūba*s of the Mughal Empire are unaccompanied by any cartographic representation.

Monserrate reports that on one occasion while meeting a Jesuit priest, Akbar had 'an atlas brought and asked where Portugal was, and where his own kingdom'.[1] Could this have been a European atlas? The fact that Akbar 'wondered how we knew the names of the provinces and cities of India' indicates the priest's familiarity with the atlas and perhaps points to the possibility of its being a European specimen.

We have only one documented instance of response to European cartography. Sir Thomas Roe presented a copy of Mercator's last edition of the Maps of the World—'a faire Booke well bound, filleted and gilt'—to Jahāngīr. Roe observed: '. . . he [Jahāngīr] sent for the Mapbooke, and told me he had showed it his *Mulaies* [Mullahs], and no man could reade nor understand it; therefore if I would, I should have it againe. I answered: At his pleasure; and it was returned.'[2]

We suspect that this atlas was not put before any geographer at Jahāngīr's court. We do not know the names of the learned individuals who refused to take interest in the atlas. But it does not imply that European maps failed to excite any curiosity among Indians. Just a few years later, Pelsaert, the Dutch traveller, drew up a long list of articles which were 'recommended to me by different nobles and great men, and which should be sent here by our ships': this list included maps of the entire world.[3] Apart from this, we have shown above (ch. II, p. 36) how European globes had become familiar to Indians. What, if any, influence these maps and globes exercised on Indian cartography is worth examining.

Availability of maps prepared in India is a rarity: perhaps this may be due to lack of interest in such matters among the modern scholars of Medieval India. Nevertheless, a dedicated search by Irfan Habib has brought forth a very precious 'Atlas' prepared in 1647 by Sādiq Isfahānī of Jaunpūr.[4] Concerning the lay-out of the maps in this Atlas, Sādiq Isfahānī was strictly following the Arabian tradition in putting the south at the top and north at the bottom.[5] This is in sharp contrast to the European map of India appended to Bernier's account of his

travels.[6] Following the same tradition, Sādiq's maps do not take into account the earth's curvature in reference to meridians. Again, points have not been used for indicating a particular place; instead, the names of towns have been placed in the squares formed by the parallels and meridians. However, the use of systematic symbols showing physical features perhaps betray some remote borrowing from Europe; also, in representing the outline of the Indian coast-line as a peninsula, Sādiq may have been inspired by European maps. But this is mere conjecture.

APPENDIX F

Lantern

We have made a passing reference to lanterns (ch. II, p. 36) which were used aboard European ships, especially since the second half of the seventeenth century. That such lanterns were in short supply in India is evident from the English factors' letters.[1] These lanterns for ships essentially consisted of a candle with a shade or covering supported by metallic strips. The shade or covering was made not of glass, but of animal horn cut into transparent sheets. Pyrard refers to such horn-lanterns.[2] One such lantern used on a ship in the late eighteenth century in England has been preserved in the Museum of the History of Science, Oxford.

Although we do not possess direct evidence on the use of lanterns on Indian ships of European make as a regular practice, it is worth considering whether this excluded the use of Indian lanterns. Mughal paintings, while depicting incidents at night, often include lanterns consisting of a candle with a transparent shade or covering, supported by a metallic frame, almost oval in shape.[3] The shade or covering is definitely not of glass since there is no evidence to indicate glassware of this type being manufactured in India, or imported from outside. Most probably, the material for the shade was animal horn like its European counterpart. If this inference is correct, it by no means establishes that it was adopted under the European influence. In fact, such lanterns were used in Persia: they have been shown in a Persian painting which depicts an outdoor night-scene.[4] It is clear, then, that the Mughals must have brought this item to India from their culture-area. But it does not answer our query, that is, whether Indians used this horn-lantern on ships. Mughal paintings place these lanterns mostly in indoor domestic scenes with a few exceptions when they are shown being used for night-hunting, at the royal court, for outdoor assembly, and in wedding processions at night.[5] However, these lanterns do not appear to be sturdy enough for use on ships; again, the manner in which they are shown to have been often carried by men makes its use for shipping a little doubtful. We know of one Mughal painting which shows one such lantern hanging from a rope or cord;[6] on the other hand, the majority of Mughal paintings depict these lanterns on the floor. The Persian painting cited above shows at least one lantern being hung to a tree by an attendant while other lanterns have been shown on the ground. Anyway, its use for shipping is not established by positive evidence.

APPENDIX G

European Contribution to the Fauna of India

The first place should be given to the several breeds of dogs brought to India. Abul Fazl says that Akbar liked dogs for their excellent qualities, and he imported them from all countries. But he does not mention any region other than Kābul and Hazāra.[1] The list of goods desired to be furnished as presents to Jahāngīr which Muqarrab Khān gave to the English factors in 1614 included dogs of several varieties, e.g. mastiffs, greyhounds, spaniels and other small dogs.[2] In 1617, Roe asked for male and female mastiffs, tall Irish greyhounds and 'such other Dogges as hunt in our land', to be sent from England for Jahāngīr.[3]

The main purpose of the demand for European dogs was for use in hunting. The Mughal Emperors frequently used trained leopards and sometimes *siyāh gosh* (lynx?) while hunting antelopes:[4] Akbar possessed 1,000 leopards.[5] But this does not imply that dogs were excluded. During Akbar's reign, dogs are reported to have been used even in hunting tigers.[6] Jahāngīr in 1607 speaks of a dozen fast-hunting dogs in the hunting of antelopes.[7] In 1615, the Persian envoy presented nine large European hunting dogs at Jahāngīr's request.[8] In the same year two Mughal nobles also gave him a large number of greyhounds (*sagi tāzī*),[9] while in 1621 another envoy from Persia presented him seven greyhounds.[10] Not surprisingly, therefore, a European traveller records that Jahāngīr possessed four hundred 'dogges for hunting as greyhounds and other'.[11] We are told that the King of Golconda was also interested in possessing English mastiffs, Irish greyhounds and water spaniels.[12]

As for the nobles, it is reported that the governor of Ahmadābād expressed his keenness in 1614 to see English mastiffs which 'to them seemed strainge'.[13] In the 1670s, it was noticed that the 'Great Men' possessed Persian greyhounds.[14] There is every reason to presume that they must have kept dogs of European breed also. In fact, one Dilīr Khān is reported in 1671 to have been given English greyhounds in return for a *siyāh gosh* given to the English factors to be sent to England.[15] Manucci speaks of another high official, Dāu'd Khān Pannī, who had a great love for dogs and other rare animals.[16] Presumably his menagerie contained European dogs too.

Comparing Indian and European dogs, Terry notes: 'Their dogs for chase are made somewhat like our grayhounds, but much lesse; they open not (do not give tongue) in the pursuite of the game.'[17]

He further adds that 'they hunt likewise with leopards'.[18] It seems that the number of dogs imported from Europe was never very large; at any rate, demand might have declined during the subsequent reigns of Shāh Jahān and Aurangzeb. In 1689, another European remarked:

> In hunting their Antilopes and Deer, as they are destitute of Dogs, so they endeavour to supply their want by tame leopards, train'd and brought up for that purpose, which warily leap upon the prey, and having once caught it, hold it fast.[19]

Apart from the meagre supply, especially the water-spaniel, an additional reason for the small number of the European dogs was the fast rate of mortality since they degenerated after 'a litter or two' on account of the intense heat in India.[20]

Another purpose of obtaining European dogs was to seek pleasure from their frolic. In 1614, a request was made for a 'curld water spanniell' and 'bloodhounds' to be sent from England because Indians could hardly be persuaded to believe that dogs could be taught to fetch or find things lost.[21] Ovington provides an interesting account of the European dogs' frolics:

> A considerable value is set upon any of our European Dogs, either Spaniels, Greyhounds, or Mastiffs. A water Spaniel, in the River of Tappy [Tāpti] after a Duck, will call forth the whole city [Sūrat] to the pastime; and 'tis with them upon this score so very amazing and delightful, because they have none of that Breed among them; nor indeed any other, that I ever saw, but currs . . .[22]

Coming to fowls, we find that the Turkey-cock (*Meleagris galhpavo*) is one of these which has survived in India to the present day. Originally a native of Mexico, it was brought to Europe in 1600 and came to Goa with the Portuguese. It was introduced in North India by Muqarrab Khān in 1612 from Goa where he had gone to bring novel things for the Mughal court.[23]

Again, Mundy saw a few 'strange' and 'stately' fowls in a lake at Goa which were brought from Mozambique by the Portuguese, and has described them: 'It is as tall as a crane, somewhat bigger, with great high tuffts on his head (like twisted bristles) as bigg as a Mans Fist.'[24]

It could have been the crowned crane (*Balearica regulorum*)—the Mahem of the Dutch colonists—common throughout south and south-west Africa.[25] It is difficult to say whether it was brought to the north or not.

The same traveller also noticed two dodos at Sūrat in 1628 with the English factors.[26] The suggestion that a dodo might have been pre-

sented to Jahāngīr, since it appears in a Mughal painting, may be accepted;[27] our only regret is that had the Mughal court developed a regular 'gastronomic interest' in this fowl, it might not have been extinct today.

APPENDIX H

Sand Clock

Recently, it has been very ably shown by my friend Dr S.R. Sarma that, 'at least tentatively', the sand clock 'developed independently both in India and Europe.' According to him, its working was described and explained for the first time in AD 1428 by Ramachandra Vajapey in his *Yantraprākasa*, who called it *kācayantra* ('glass instrument') that measured one *ghati*. Further, Sarma notes that Ramachandra's description of the sand clock is based neither on a European source nor on Islamic prototype. However, he concedes that all the sand clocks depicted in the Mughal miniatures are not of Indian origin. Actually, we have not discovered any Mughal painting of this article answering to the Indian provenance. This absence is significant, especially in the light of Sarma's observation that the ' . . . Mughal court may have used the European sand clock side by side with indigenous ones to measure hours with one and the *ghatis* with the other' (see Sreeramula Rajeswara Sarma, 'Astronomical Instruments in Mughal Miniatures' in *Studien zur Indologie und Iranistik*, 16/17, Reinbek, 1992, pp. 235–76: on sand clock, pp. 243–47).

An important fact missed by all of us is the absolute silence on the use of the sand clock in the Persian sources during the Delhi Sultanat.

NOTES

(to Pages 1–3)

INTRODUCTION

1. V. Slomann, *Bizarre Designs in Silks*, p. 92.
2. For example, see Tapan Raychaudhuri, *Jan Company in Coromandel, 1605–1690: A Study in the Interrelations of European Commerce and Traditional Economics*. The latest additions are: M. N. Pearson, *Merchants and Rulers in Cujarat: The Response to the Portuguese in the Sixteenth Century*; Susil Choudhury, *Trade and Commercial Organization in Bengal, 1650–1720 A.D.*; Surendra Gopal, *Commerce and Crafts in Gujarat, 16th and 17th Centuries: A Study in the Impact of European Expansion on Precapitalistic Economy*.
3. Cf. C. R. Boxer's four monographs: (a) *Race Relations in the Portuguese Colonial Empire, 1415–1825*; (b) *Portuguese Society in the Tropics*; (c) *The Dutch Seaborne Empire, 1600–1800*; (d) *The Portuguese Seaborne Empire, 1415–1825*.
4. Boxer, *The Dutch Seaborne Empire*, p. 194.
5. Angus Maddison, *Class Structure and Economic Growth: India and Pakistan since the Mughals*, p. 21.
6. Vikas Misra, *Hinduism and Economic Growth*, p. 65.
7. Ibid., p. 53. Cf. C. A. Alvares, *Homo Faber: Technology and Culture in India, China and the West, 1500–1972*, pp. 46–8, for other similar views.
8. Surendra Gopal, 'Social Set-up of Science and Technology in Mughal India', *IJHS*, iv, May and Nov. 1969.
9. See Bose, Sen and Subbarayappa, *A Concise History of Science in India*, pp. 484–5.
10. Ibid., p. 593.
11. On the want of patronage, see M. A. Alvi and A. Rahman, *Fathullah Shirazi —A Sixteenth Century Indian Scientist*, pp. 1, 26.
12. Robert Orme, *Historical Fragments of the Mogul Empire*, p. 306. For diet, see E. Huntington, *Mainsprings of Civilization*, pp. 205, 306.
13. Orme, p. 299.
14. C. Northcote Parkinson, *Trade in the Eastern Seas, 1793–1813*, p. 6.
15. We may refer here to two studies relating to the eighteenth and nineteenth centuries. The first is that by Sabyasachi Bhattacharya, who chose three specific items of Western technology to examine the organizational and economic reasons for Indian diffidence in adopting them and, then, dismissed observations that ascribe such responses to disposition, prejudices and habits (see 'Cultural and Social Constraints on Technological Innovation', *IESHR*, iii, no. 3, Sept. 1966). The second is by Henry T. Bernstein, who has examined the development of steamboats in the Indian social and economic milieu (*Steamboats on the Ganges*, Orient Longmans, 1960).
16. Arnold Pacey, *The Maze of Ingenuity: Ideas and Idealism in the Development of Technology*.
17. Cf. C. S. Smith in his review of two books in *Technology and Culture*, xviii, no. 1, Jan. 1977, p. 85.

Chapter I PROLOGUE

1. See C. R. Boxer, *The Dutch Seaborne Empire, 1600–1800*, and *The Portuguese Seaborne Empire, 1415–1825*. Also F. C. Danvers, *The Portuguese in India etc.*; R. S. Whiteway, *The Rise of Portuguese Power in India, 1497–1550*; Donald F. Lach, *India in the Eyes of Europe*; G. R. Crone, *The Discovery of the East*. See also I. A. Macgregor, 'Europe and the East', in *The New Cambridge Modern History*, ii, pp. 591–614, and J. B. Harrison, 'Asia and Africa', ibid., iii, pp. 532–58.
2. For some references to *sarā'is* (inns), see Bosworth's account in *The Voyage of Nicholas Downton to the East Indies, 1614–15*, pp. 105, 138. Also F. S. Manrique, *Travels, 1629–43*, tr. C. E. Luard, ii, pp. 99–102. The accounts of Tavernier, John Marshall and Manucci and many other European travellers contain profuse references to *sarā'is*.
3. *The Voyage of Francis Pyrard of Laval*, tr. and ed. A. Gray, ii, p. 334.
4. *The Indian Travels of Thévenot and Careri*, tr. and ed. S. N. Sen, p. 135.
5. Thomas Bowrey, *A Geographical Account of Countries Round the Bay of Bengal, 1669 to 1679*, ed. R. C. Temple, p. 195. Also see Thévenot, in *The Indian Travels of Thévenot and Careri*, tr. and ed. S. N. Sen, p. 95; Tavernier, *Travels in India, 1640–67*, tr. V. Ball, p. 125; John Burnell, *Bombay in the Days of Queen Anne*, pp. 153–4.
6. See 'Portuguese Christian Communities in Bengal, 1679 A.D. (Reports of the Augustine Monks of Goa)', tr. Talwalkar, with notes by Jadunath Sarkar, *Bengal, Past and Present*, lxx, pp. 1–6.
7. See Francis Goldie, *First Christian Missions to the Great Mogul*; also, E. Maclagan, *The Jesuits and the Great Mogul*; C. H. Payne, *Akbar and the Jesuits*.
8. C. H. Payne, *Jehangir and the Jesuits*.
9. See ch. iii.
10. Cf. Edward's account in *Voyage of Downton*, p. 172.
11. Downton's account, p. 11. For specific items sought by the Mughal ruling class, see app. B. Other items, not included in this appendix, have been mentioned at appropriate places in the chapters that follow.
12. Sir Thomas Roe suggested as gifts for Nūr Jahān: 'fine needle work toyes, fayre bone lace, cuttworke, and some handsome wrought wastcoate, sweet bagges or cabinetts . . .' He also speaks of European hats, 'his women liked them' (see *The Embassy of Sir Thomas Roe to the Great Mogul, 1615–1619*, ed. W. Foster, pp. 119, 386).
13. See E. Maclagan, p. 121; also Manrique, ii, pp. 206 ff., 330.
14. E. Maclagan, p. 77.
15. Abul Fazal, *Akbarnāma*, iii, pp. 146, 228.
16. 'Nadir Zaman' brought two thrones from Goa, 'one for the King and the other for the Begum, which are very heavy but very good' (see the *English Factories in India, 1618–69*, ed. W. Foster, 13 vols. (henceforth *EF*), 1624–9, p. 93).
17. *Voyage of Downton*, p. 104.
18. *EF*, 1646–50, p. 338.
19. *The East India Company Journals of Captain William Keeling and Master Thomas Bonner, 1615–1617*, ed. M. Strachan and B. Peurose, pp. 116, 117.

20. Ibid., pp. 125–6.
21. *Ā'īn-i Akbarī*, iii, p. 26.
22. J. Fryer, *A New Account of East India and Persia, being Nine Years' Travels, 1672–81*, ed. W. Crooke, i, p. 326.
23. Ibid., pp. 335, 336.
24. Ibid., p. 334.
25. J. Talboys Wheeler, *A History of the English Settlements in India*, pp. 24–7.
26. Tavernier, i, p. 273.
27. Manrique, ii, p. 209.
28. Cf. E. Maclagan, p. 116.
29. Ibid.
30. Tavernier, i, p. 111.
31. Ibid., p. 163.
32. F. Bernier, *Travels in the Mogul Empire, 1656–68*, tr. A. Constable, pp. 324-5, 339, 352–3.
33. N. Manucci, *Storia do Mogor, 1653–1708*, tr. William Irvine, iv, pp. 157–8.
34. *Purchas His Pilgrimes*, ii, p. 302.
35. Bowrey, pp. 33–4.
36. Careri in *The Indian Travels of Thévenot and Careri*, tr. and ed. S. N. Sen, p. 247.
37. Fryer, ii, p. 102.
38. See M. P. Singh, 'The Custom and Custom House at the Port of Surat during the Seventeenth Century', *QRHS*, x, no. 2, 1970–1.
39. See A. J. Qaisar, 'The Role of Brokers in Medieval India', *IHR*, i, no. 2, 1974.
40. Fryer, i, p. 212.
41. Cf. Irfan Habib, 'Banking in Mughal India', *Contributions to Indian Economic History*, i, 1960, pp. 1–20. Also, A. J. Qaisar, 'Merchant Shipping in India during the Seventeenth Century', *Medieval India—A Miscellany*, no. 2, pp. 195–220.
42. Zain-ud-dīn, *Tuhfat-al Mujāhīdīn*, tr. M. H. Nainar, University of Madras, 1942, p. 56. Also see M. N. Pearson, 'Cafilas and Cartazes', *IHC*, 1968.
43. A. J. Qaisar, 'Merchant Shipping etc.', p. 215.
44. For *Adaviya*, cf. *The Travels of Peter Mundy in Europe and Asia, 1608–67*, ii, p. 291 ('. . . Adowyaes, whom also theie are two sorts of contracts, one to give him soe much for his paines to goe along with us to compound the Jagatt [taxes] and wee pay it on our owne heads, Another to give him soe much per cart or cammell, and hae to pay the said customs to his proffitt or losse').
45. Cf. A. J. Qaisar, 'The Role of Brokers etc.'
46. Ibid., p. 245–6.
47. Ibid., p. 236.
48. *EF*, 1618–21, p. 198; also Athar Ali, *The Mughal Nobility Under Aurangzeb*, p. 157, n. 2.
49. Bernier, p. 44.
50. Bowrey, p. 105, n. 2.
51. *EF*, 1646–50, pp. 59, 64–5.
52. Cf. Bowrey, p. 214 and n. 2; p. 215, n. 1. Also, V. Slomann, *Bizarre Designs in Silks*, pp. 110–11; p. 111, nn. 1 and 2.
53. See p. 37.
54. Tavernier, ii, p. 12; *John Marshall in India—Notes and Observations*, ed. S. A.

Khan, pp. 23–4; F. Pelsaert, 'Remonstrantie', tr. W. H. Moreland and P. Geyl as *Jahangir's India*, p. 46. Also see J. N. Sarkar, 'Transport of Saltpetre in India in the Seventeenth Century', *JBORS*, xxv, pt i, 1939, pp. 34–51.

55. Tavernier, i, p. 116.
56. Ibid., pp. 301–3.
57. Ibid., p. 393.
58. Cf. *EF*, 1534–6, pp. 51, 292; 1637–41, pp. 186, 187, 257–8; 1642–5, p. 37; 1646–50, pp. 293–4; 1661–4, p. 229. Also see J. C. De, 'Lashkar in Indian Historical Documents (1600 to 1661)', *Bengal, Past and Present*, lxi, 1941, pp. 71–81; Lach, p. 416, n. 586.
59. See *Journals of Keeling and Bonner*, p. 109 and n. 175. Also, *EF*, 1668–9, p. 21.
60. Cf. Manrique, ii, pp. 13, 228; Fryer, i, p. 171.
61. J. Ovington, *A Voyage to Surat in the Year 1689*, ed. H. G. Rawlinson, p. 234.
62. Ibid., p. 231.
63. Thomas Coryat in *Early Travels in India*, ed. Foster, p. 284.
64. Ovington, p. 228; also, Fryer, i, p. 218.
65. *The Life of the Icelander Jon Olafsson*, tr. D. B. Phillpotts, ii, p. 163. Also, Dennis Kincaid, *British Social Life in India*, p. 8.
66. Ibid., p. 107.
67. Careri, pp. 188–9.
68. Cf. Manrique, ii, p. 317, 323 ff.
69. E. Maclagan, p. 103.
70. E.g. Bernier, p. 267.
71. Cf. Dennis Kincaid, p. 61; also Boxer, *The Dutch Seaborne Empire*, p. 223.
72. J. T. Wheeler, *A History of English Settlements in India*, pp. 49, 54.
73. See Zain-ud-dīn, *Tuhfat-al Mujāhīdīn*, p. 60. For an excellent treatment of this aspect, M. N. Pearson, *Merchants and Rulers in Gujarat: The Response to the Portuguese in the Sixteenth Century*, ch. i.
74. Pyrard, i, pt i, p. 347.
75. *Journals of Keeling and Bonner*, p. 197.
76. Mundy, v, p. 61.
77. Tavernier, i, p. 177.
78. Manrique, ii, pp. 336–7.
79. Ibid., p. 331.
80. Ibid., p. 263.
81. Ibid., p. 264.
82. Terry in *Early Travels in India*, ed. Foster, p. 314.
83. Tavernier, i, p. 391.
84. Fryer, i, p. 302.
85. Cf. Manucci, iv, pp. 365–6.
86. Manrique, ii, pp. 225–6. Also Manucci (ii, p. 40): '. . . imagining that I was a physician as they suppose all Europeans to be . . .'
87. Manrique, ii, p. 112.
88. Ibid., p. 219.
89. Ibid., p. 320.
90. Ibid., p. 105.
91. Pyrard, ii, pt i, p. 249.

92. Cf. Birdwood, *Industrial Arts of India*, p. 133.
93. Terry in his *Voyage to the East Indies*, 1655 ed. (cited in Birdwood, p. 134).
94. Pelsaert, p. 9.
95. Ovington, pp. 166–7.
96. Bowrey, p. 105.
97. Fryer, i, p. 267. Cf. also Boxer, *The Dutch Seaborne Empire*, p. 213.
98. Fryer, i, p. 267.
99. Cf. Boxer, *Jan Campagnie in Japan, 1600–1817*, p. 28.
100. Ibid., pp. 29, 39. See also Michael Edwardes, *Asia in the European Age, 1495–1955*, p. 10: 'To deny access to European ideas by preventing colonial subjects from acquiring Western languages or education, as the Dutch did in Indonesia, merely delayed the impact.'

Chapter II TECHNOLOGY

1. Cf. Ralph Davis, *The Rise of the English Shipping Industry*. For details of some ships under construction, see *The Papers of Thomas Bowrey*. Also see K. N. Chaudhuri, *The English East India Company*, ch. v. For an assessment of the evidence on this theme in the Persian sources, see A. J. Qaisar, 'Nature of Evidence for Shipping in the Persian Sources: A Selective Study', paper presented at a seminar on 'Indian Maritime History—A.D. 1500–1800' held at Visva-Bharati, Santiniketan, March 1979 (cyclostyled).
2. See A. J. Qaisar, 'Shipbuilding in the Mughal Empire during the Seventeenth Century', *IESHR*, v, no. 2, June 1968, p. 150. As early as A.D. 1292, John of Monte Corvino noticed the absence of caulking in ships on the south-west coast of India (cf. *Cathay and the Way Thither*, tr. and ed. Col. Yule, revised Cordier, ii, p. 66).
3. Such as scarfing, scoring, tenanting, rabbeting, etc. Cf. Qaisar, 'Shipbuilding etc.', p. 150, nn. 5 and 6.
4. A 'groove or cut made in the edge of one plank, etc. so that another similarly cut may fit into it' (ibid., p. 150).
5. Cf. Pl. 3/117 (*Akbarnāma*, V & A): 'Akbar Going to Agra by Boat'. Also, *Dārābnāma*, BM Or. 4615, f. 31a; ibid., f. 76b. For other methods, see *Dārābnāma*, f. 55a. See also S. P. Verma, *Art and Material Culture in the Paintings of Akbar's Court*, Pl. lxxi.
6. Oakum was made of loose fibre or untwisted old ropes, etc. mixed with melted pitch.
7. Qaisar, 'Shipbuilding etc.', p. 151, n. 10.
8. See *The Travels of Ludovico di Varthema, 1503–1508*, tr. J. W. Jones, pp. 152 ff. I committed a mistake when, with reference to Marco Polo's account (*Purchas His Pilgrimes*, xi, p. 291), I concluded that Indian ships were caulked in the European manner in the early fourteenth century (see Qaisar, 'Shipbuilding etc.', p. 151). Actually the use of oakum in his account refers to the Chinese ships which he calls 'ships of Manzi' (cf. *The Book of Ser Marco Polo*, tr. and ed. Col. Yule, ii, pp. 249–51). Also see J. Needham, *Science and Civilization in China*, iv, pt iii, p. 466, n. (g).
9. *The English Factories in India*, 1646–50, pp. 90–1.

10. See below, ch. II.
11. E.g., T. Bowrey, *A Geographical Account of Countries Round the Bay of Bengal, 1669 to 1679*, ed. R. C. Temple, p. 102. Also, N. Manucci, *Storia do Mogor, 1653–1708*, tr. W. Irvine, ii, p. 387 n.
12. Cf. Qaisar, 'Shipbuilding etc.', pp. 160, 162.
13. Varthema, p. 152.
14. Qaisar, 'Shipbuilding etc.', p. 153.
15. *EF*, 1668–9, p. 79.
16. K. N. Chaudhuri, p. 98.
17. Qaisar, 'Shipbuilding etc.', pp. 162–3.
18. Ibid., p. 162, n. 117.
19. *Travels of Abbé Carré in India and the Near East, 1672–74*, iii, p. 781.
20. *EF*, 1668–9, p. 79.
21. Qaisar, 'Shipbuilding etc.', p. 162.
22. *Cathay and the Way Thither*, ii, p. 66. For the absence of iron in ships in ancient India, see Mamata Chaudhuri, 'Shipbuilding in the *Yuktikalpatru* and *Samarangana Sutradhara*', *IJHS*, ii, no. 2, Nov. 1976, pp. 137–47. Also see Lallanji Gopal, 'Art of Shipbuilding and Navigation in Ancient India', *JIH*, xl, 1962, pp. 313–28.
23. See Qaisar, 'Shipbuilding etc.', p. 153, n. 23. Cf. the account of Stefano in *India in the Fifteenth Century*, ed. R. H. Major, p. 3. For the remark of Friar Odoric of Pordenone in 1316, see *Cathay and the Way Thither*, ii, pp. 112–14. Also W. H. Moreland, 'The Ships of the Arabian Sea about A.D. 1500', *JRAS*, Jan. 1939, pp. 63–74 and April 1939, pp. 173–92. G. F. Hourani, *Arab Seafaring in the Indian Ocean in Ancient and Early Medieval Times*, pp. 94–7. Once again, I was misled by Marco Polo's account in *Purchas*, xi, to conclude that Indians used iron nails in the early fourteenth century (cf. Qaisar, 'Shipbuilding etc.', p. 153, n. 22).
24. Needham, iv, p. 467.
25. R. K. Mookerji, *Indian Shipping: A History of the Seaborne Trade and Maritime Activity of the Indians from the Earliest Times*; Moreland, 'The Ships of the Arabian Sea', and Hourani.
26. Needham, iv, p. 465.
27. Moreland, 'The Ships of the Arabian Sea', pp. 184–5; Hourani, pp. 95–6.
28. J. Ovington, *A Voyage to Surat in the Year 1689*, ed. H. G. Rawlinson, p. 166.
29. Hourani, p. 96.
30. Ibid., p. 97; Moreland, 'The Ships of the Arabian Sea', p. 189.
31. S. Maqbul Ahmad, 'The Arabs and the Rounding of the Cape of Good Hope', *Dr. Zakir Hussain Presentation Volume*, New Delhi, 1968. Also see Moreland, 'The Ships of the Arabian Sea'.
32. See R. S. Whiteway, *The Rise of the Portuguese Power in India, 1497–1550*.
33. Needham, iv, p. 515.
34. Moreland, 'The Ships of the Arabian Sea', p. 181.
35. Ibid.
36. See *The Voyage of Pedro Alvares Cabral to Brazil and India*, tr. W. B. Greenlee, p. 105.
37. Varthema, p. 152.
38. Abul Fazl, *Akbarnāma*, iii, pp. 651–2.

39. See *Dārābnāma*, BM Or. 4615, f. 55a, f. 75b.
40. W. H. Moreland, *India at the Death of Akbar*, p. 140; also cf. Methwold's account in *Relations of Golconda in the Early Seventeenth Century*, tr. and ed. Moreland, p. 34.
41. Methwold, p. 36; anonymous account in *Relations*, p. 80.
42. Cf. Qaisar, 'Shipbuilding etc.', p. 153, n. 23; also *The Life of the Icelander Jon Olafsson*, tr. D. B. Phillpotts, ii, p. 144.
43. The ease with which the Portuguese, at one sweep, captured and tried to burn ten great ships and 120 coastal vessels at Gogha in 1614 is a case in point (cf. *Purchas*, iv, pp. 225–6).
44. Varthema, p. 153.
45. Ibn Mājid, *Arab Navigation in the Indian Ocean*, tr. G. R. Tibbetts, pp. 55–6.
46. For the use of stone killicks in ancient India, see Moti Chandra, *Trade and Trade Routes in Ancient India*, p. 220, where the author cites a Sanskrit source, *Tilakmanjarī* of Dharampala (*c.* A.D. 774–995 or 1010–25). For a brief reference to the transition of anchors from stone and wood to iron in India, see J. W. Nouhuys, 'The Anchor', *Mariner's Mirror*, xxxvii, 1951, pp. 21–5.
47. Cf. *Miftāh-ul Fuzalā'*, BM Or. 3299, s.v. *langar*.
48. See *Farhang-i Jahāngīrī*, Nawal Kishore Edition (undated), s.v. *langar*.
49. Tek Chand, *Bahār-i 'Ajam*, s.v. *langar*.
50. Cf. *Mir'at-ul haqā'iq*, Bodleian, Fraser no. 124, f. 435b.
51. *The East India Company Journals of Captain William Keeling and Master Thomas Bonner, 1615–1617*, ed. Michael Strachan and Boies Peurose, pp. 125–6. It weighed 13 cwts., and cost 700 *mahmūdī*s (one *mahmūdī* was equivalent to 2/5 of a rupee).
52. Bowrey, p. 102.
53. A. Hamilton, *A New Account of the East Indies*, p. 217.
54. Ibid.
55. *EF*, 1660–4, p. 25.
56. Ibid., p. 211; 1668–9, p. 36.
57. Ibid., 1670–7, p. 239.
58. Safī bin Walī Qazwīnī, *Anīs-ul hujjāj*, Pl. 2: 'Ships Sailing in the Sea off Oman'.
59. B. S. Shastry, 'The System of Cartazes', *JIH*, Aug. 1973, pp. 297–300.
60. Bowrey, Pl. xiii.
61. Ibid., Pl. xv.
62. Cf. A. H. Hill, 'Some Early Accounts of the Oriental Boat', *Mariner's Mirror*, xliv, 1958, p. 212.
63. P. K. Gode, 'Notes on the History of Rope-Manufacture in India', *Studies in Indian Cultural History*, iii.
64. *The Voyage of John Huyghen Van Linschoten to the East Indies*, ii, p. 46.
65. Bowrey, pp. 104–5.
66. *EF*, 1637–41, p. 201.
67. Ibid., 1646–50, p. 81; 1651–4, p. 119.
68. Bowrey, p. 105.
69. Ibid., p. 293.
70. Ibid., i, p. 103. (*dammar* was used for caulking purposes.)
71. *EF*, 1661–4, p. 24.
72. J. Burnell, *Bombay in the Days of Queen Anne*, pp. 23–4.

73. The English at Bombay wrote in 1668: 'Cables and running rigging we make here of the countrey stuffe farr cheaper and full as serviceable' (cf. *EF*, 1668–9, p. 80).
74. *The Voyage of Francis Pyrard of Laval*, tr. and ed. A. Gray, ii, pt ii, p. 258; Linschoten, i, pp. 67, 268; Qaisar, 'Merchant Shipping etc.', p. 197.
75. Qaisar, 'Merchant Shipping etc.', p. 196.
76. *Anīs-ul hujjāj*, p. 12.
77. See Ibn Mājid, p. 537. Also F. Steingass, *Persian–English Dictionary*, s.v. *fintās*.
78. *EF*, 1646–50, p. 91.
79. Pyrard, ii, pt ii, p. 259.
80. Ibid.
81. *EF*, 1668–9, p. 79.
82. Pyrard, p. 258.
83. E.g. *EF*, 1646–50, p. 91.
84. S. A. Khan, *Sources of British India in the Seventeenth Century*, p. 272 (the evidence is from the India Office *Marine Records*, Misc., xxvii, pt i).
85. *Anīs-ul hujjāj*, pp. 12–13.
86. See Qaisar, 'Merchant Shipping etc.', p. 196.
87. Ibid., p. 197, n. 5.
88. *Anīs-ul hujjāj*, p. 15.
89. See *Dārābnāma*, BM Or. 4615, f. 34a: 'Tamarusa and Shapur at the Island of Nigar'. Also, *Bāburnāma*, Pl. 91: 'Babur meets his cousin while encamped on the bank of the Oxus River in 1504' (reproduced in Michael Goedhuis, *Indian Painting*, London, 1978).
90. Cf. *Purchas*, iii, pp. 264, 297–8; ibid., v, pp. 2–3, 9; Tavernier, *Travels in India*, tr. V. Ball, i, p. 255; Olafsson, ii, pp. 212–13.
91. Needham, iv, pt iii, pp. 666, 667. The reason for the shift to chain-pumps was that it 'takes up twice as much water as the ordinary did' (cf. ibid., p. 667, n. (a)). That it was a new device for the English is clearly shown by Downton's account in 1611 (*Purchas*, iii, pp. 297–8) when he narrates the problems that the frequent breakdowns of the iron-chains created.
92. Martin Pring's account (1616) of pumps indicates that these were piston-pumps since he says that 'the pumps did *suck* so much in the space of half an hour . . .' (emphasis ours). Cf. *Purchas*, v, pp. 2–3.
93. Needham, iv, pt iii, p. 666. He identifies it as the inclined square-pallet chain-pump (also see, ibid., iv, pt ii, p. 339).
94. Qaisar, 'Merchant Shipping etc.', p. 198, n. 1.
95. Tavernier, i, p. 255.
96. Qaisar, 'Merchant Shipping etc.', pp. 201–2.
97. Ibid., p. 201. Compare also Tavernier (i, p. 255) where he says that 'The Dutch company is in the habit of supplying a pilot and a sub-pilot and two or three gunners to the vessels which belong to the kings or princes of India . . .'
98. See *The Oxford English Dictionary* (henceforth *OED*), ii, s.v. *capstan*.
99. Cf. Needham, iv, pt iii, p. 667, n. (a); also, *OED*.
100. *Sīrat-i Feroze Shāhī*, Bankipur/vii/547, ff. 94b–102a.
101. Cf. *The Voyage of Pedro Alvares Cabral to Brazil and India*, tr. W. B. Greenlee, p. 105.
102. Cited in Pyrard, ii, pt ii, p. 344, n. 2.

103. Ibid., p. 344.
104. Ibid., ii, pt i, p. 183.
105. *Travels of Peter Mundy in Europe and Asia, 1608–67*, iii, p. 59.
106. Bowrey, pp. 102–3. He also describes the practice of hauling elephants to the shore from ships with the help of 'a good capstant or two' (ibid., pp. 75, 181).
107. Cf. Manucci, ii, p. 387 n. Also Bowrey, pp. 102–3.
108. Needham, iv, pt iii, pp. 664, 697.
109. Qaisar, 'Shipbuilding etc.', p. 153 and n. 28.
110. Compare, for example, *EF*, 1618–21, p. 314.
111. See *The Papers of Thomas Bowrey*, p. 167, n. 4. Needham says that the Romans tried sheathing ship bottoms with lead; it was tried again in Europe around 1525, but soon abandoned in favour of sheathing with a layer of planks till 1758, when copper took its place (cf. iv, pt iii, p. 664). It seems that Needham inadvertently missed the evidence about lead in the late seventeenth century. Also see Olafsson, ii, p. 61, for the use of lead in the 1660s.
112. Pyrard, ii, pt ii, p. 388.
113. Needham, iv, pt iii, p. 697.
114. Payton's account in *Purchas*, iv, p. 301. I regret the enthusiasm which led me to transfer this evidence to India (see Qaisar, 'Shipbuilding etc.', p. 152).
115. Needham, iv, pt iii, p. 665.
116. *EF*, 1668–9, p. 160.
117. *The Embassy of Sir Thomas Roe to the Great Mogul, 1615–1619*, ed. W. Foster, p. 97.
118. *A Supplementary Calendar of Documents in the India Office Relating to India or to the Home Affairs of the East India Company, 1600–1640*, ed. W. Foster, p. 83.
119. *EF*, 1651–4, p. 85.
120. Ibid.
121. I.O., *Surat*, G/36/8, July 1703, pp. 841–5.
122. For two telescopes being given in gift to the Nawab of Patna, see I.O., *Patna Diary*, G/28/1, 3 July 1683.
123. Galileo had already used it for astronomical purposes in the early seventeenth century.
124. Tavernier, i, p. 130.
125. Edward Maclagan, *The Jesuits and the Great Mogul*, pp. 133–4.
126. Cf. Saiyid Ahmad Khan, *Āsār-ul Sanādīd*, pp. 316–20. Also S. M. Razaullah Ansari, 'The Establishment of Observatories and the Socio-economic Conditions of Scientific Work in Nineteenth Century India', *IJHS*, xiii, no. 1, 1978, p. 63.
127. Tek Chand, *Bahār-i 'Ajam*, s.v. *dūrbīn*. Also see Irfan Habib, 'The Technology and Economy of Mughal India', The Dev Raj Chanana Lectures, Delhi, 1970 (cyclostyled).
128. Needham, iv, pt iii, pp. 562, 576. Firth seems to think that the Arabs might have applied the knowledge of the polarity of the magnetic needle before the Chinese (cf. Fr. Hirth and W. W. Roe, *Chau Ju-Kua on the Chinese and Arab Trade*, p. 29, n. 3).
129. Cf. Needham, iv, pt iii, p. 572.
130. J. Fryer, *A New Account of East India and Persia, being Nine Years' Travel, 1672–81*, ed. W. Crooke, i, p. 142.

131. See Irfan Habib, 'Technology and Economy etc.', p. 18, n. 5.
132. See Needham, iv, pt iii, pp. 573–4; Also, Greenlee, *The Voyage of Cabral*, p. 39 and n. 1.
133. Irfan Habib, 'Technology and Economy etc.', p. 21.
134. F. Bernier, *Travels in the Mogul Empire, 1656–68*, tr. A. Constable, p. 244.
135. *The Papers of Thomas Bowrey*, p. 135 and n. 1.
136. In 1668, the English factors on the Coromandel coast required lanterns from England (see *EF*, 1668–9, p. 160). Also see Irfan Habib, 'Technology and Economy etc.', p. 21.
137. *Journals of Keeling and Bonner*, p. 183 and n. 28. The Arabs got it from Europe but do not appear to have used it for shipping; nor did the Chinese (Needham, iv, pt iii, p. 585).
138. *EF*, 1618–21, p. 21; 1646–50, p. 338.
139. R. Ettinghausen, *Paintings of Sultans and Emperors of India*, Pl. 12: 'Jahāngīr's Dream of Shāh 'Abbās's Visit'. Also see Crowe *et al.*, *The Gardens of Mughal India*, unnumbered plate facing p. 90.
140. *EF*, 1637–41, p. 183.
141. The Chinese probably used 'combustion-clocks', i.e. incense sticks (Needham, iv, pt iii, p. 570). Also see Greenlee, p. 37, n. 3, for measuring time-flow.
142. *EF*, 1618–21, p. 21; 1646–50, p. 338. For 'half-hour' and 'half-minute' glasses, see ibid., p. 106.
143. The hour-glass had come to be used for astronomical (astrological) purposes in India (see p. 76).
144. John Jourdain, *Journal, 1608–17*, ed. Foster, p. 198.
145. *EF*, 1642–5, p. 168.
146. Bowrey, p. 102.
147. Fryer, i, p. 267.
148. Ovington, p. 166.
149. He was Khurshedjī, a Parsi (cf. *EF*, 1670–7, p. 223).
150. Roe, pp. 97, 118–19.
151. Ibid., p. 322.
152. Terry in the 1655 edition of his *Travels* (cited in Roe, p. 322, n. 3).
153. Cf. Roe, pp. 320, 347.
154. *Tuzuk-i Jahāngīrī*, ed. Saiyid Ahmad Khan (henceforth *Tuzuk*), p. 167; Roe, p. 320.
155. *Tuzuk*, p. 168; also see Khursheed Mustafa, 'Travels in Mughal India', *MIQ*, iii, nos. 3 and 4, Jan. and April 1958, p. 2, n. 9.
156. Mundy, ii, p. 193.
157. *EF*, 1618–21, p. 179 (also p. 93 for 'cattle' procured for coaches).
158. Fryer, iii, pp. 157–8; i, p. 213.
159. Ibid., i, p. 178.
160. Thévenot, p. 75. We do not think that horses were used in Thatta for these coaches.
161. Tavernier, i, pp. 36–7.
162. Ovington, p. 232.
163. Roe, i, p. 322.
164. Fryer, pp. 157–8.
165. Cf. J. H. Grose, *A Voyage to the East Indies*, i, pp. 153–4.

166. F. Buchanan, *An Account of the District of Purnea in 1809–10*, p. 157.
167. Coryat in *Early Travels*, p. 252.
168. Taking a rupee to be equivalent to 2s. 3d. (W. H. Moreland, *From Akbar to Aurangzeb*, p. 329).
169. F. S. Manrique, *Travels, 1629–43*, tr. C. E. Luard, p. 145.
170. Cf. J. W. McCrindle, *Ancient India as Described by Megasthenes and Arrian*, pp. 88, 89, 141; also, *The Invasion of India by Alexander the Great*, p. 310.
171. Watters (tr.), *Yuan Chwang's Travels in India*, i, p. 171.
172. Ibid., p. 343.
173. Cf. the opinion of B. K. Majumdar, *The Military System in Ancient India*, pp. 99, 136.
174. *The Book of Duarte Barbosa, 1500–17*, tr. M. L. Dames, i, pp. 121, 141.
175. Cf. *The Commentary of Father Monserrate*, tr. and annotated by J. S. Hoyland and S. N. Banerjee, p. 199. I owe this information to my colleague, Ms Shireen Moosvi.
176. *Ā'īn-i Akbarī*, i, pt ii, p. 151 (*Ā'īn* no. 68); also see ibid., p. 199, for camels and horses being used for pulling carriages. Khursheed Mustafa reads *ghur bahl* as *ghar bahl* (house carriage) because in his opinion it was considered as comfortable and commodious as a house (cf. 'Travels in Mughal India', p. 1). But Hameeda Naqvi gives its correct reading, that is, *ghur bahl* (cf. H. K. Naqvi, *Urbanisation and Urban Centres under the Great Mughals*, p. 72).
177. Ralph Fitch in *Early Travels*, p. 18.
178. Ovington, p. 151, and n. 2. Also Tavernier, ii, p. 43: 'I come to the manner of travelling in India, where oxen take the place of horses . . .' For the early seventeenth century, cf. Terry in *Early Travels*, p. 311.
179. See *Razmnāma*, Or. 12076, f. 7b; ibid., f. 35b.
180. Cf. S. C. Welch, *Indian Drawings and Painted Sketches*, Pl. 47.
181. Mundy, ii, sketch no. 12.
181a. Compare, for example, the *Farasnāma* of Hāshmī and that of Zabardast Khān, ed. D. C. Phillot, Bib. Indica, 1910 and 1911 respectively. For horse-shoeing, see the *Farasñāma* of Muhammad bin Muhammad, School of Oriental and African Studies, London, MS. no. 46524.
182. Barbosa, ii, p. 121.
183. Bernier, p. 352; for heavy cannons see also Tavernier, i, p. 58.
184. *Ā'īn-i Akbarī*, i, pt ii, p. 208 (*Ā'īn* no. 28).
185. Cf. Arnold and Wilkinson, *The Library of Chester Beatty: A Catalogue of the Indian Miniatures*, i, Pl. 25. Also see the *Akbarnāma* (vol. i) illustrations, Victoria and Albert Museum, nos. IS 2-1896 2/117, 15/117, 24/117.
186. Arnold and Wilkinson, iii, frontispiece. Also, S. C. Welch, *Imperial Mughal Paintings*, Pl. 8.
187. Cf. *The Voyage of Thomas Best*, ed. Foster, p. 209.
188. Fryer, iii, 158.
189. Ovington, p. 134.
190. Fryer, i, p. 295.
191. Grose, p. 152.
192. Ibid., pp. 156–7.
193. Cf. F. Buchanan, *An Account of the District of Shahabad in 1809–10*, p. 165.
194. See F. Buchanan, *An Account of the District of Purnea*, p. 156.

195. Pl. ii (1786: 'Old Court House and Writers' Building'); Pl. xii (1788: 'St. John's Church').
196. *Artibus Asiae, Supplementum xxxii* (*Rajput Paintings at Bundi and Kota*), fig. 106.
197. Qaisar, 'Shipbuilding etc.', p. 168.
198. *EF*, 1661–4, p. 401.
199. Cf. *Akbarnāma*, vol. i, BM Or. 12988, f. 66a.
200. See Pl. 138 in Leigh Ashton, *The Art of India and Pakistan*.
201. *EF*, 1621–3, p. 72.
202. Qaisar, 'Shipbuilding etc.', pp. 169, 170 and n. 180.
203. Ibid., pp. 168–9.
204. Ibid., p. 169.
205. Ibid., p. 170.
206. Fryer, i, p. 267.
207. Johan Van Twist, 'A General Description of India', extracts tr. W. H. Moreland, *JIH*, xvi, pt i, 1937, pp. 74–5.
208. Abbé Carré, ii, p. 796.
209. This was a gun-port in the stern of a ship for use when being chased (cf. *Journals of Keeling and Bonner*, p. 142 and n. 276; also *EF*, 1678–4, p. 43 and n. 1).
210. Terry, p. 314.
211. Bernier, p. 48.
212. Fryer, i, p. 74.
213. Manucci, ii, p. 46.
214. Ibid., p. 47.
215. *EF*, 1670–7, pp. 224–5; 1678–84, pp. 293, 295, 301; Fryer, i, pp. 154, 182. For details, also see Abbé Carré, i, pp. 138–9.
216. Ovington, p. 93.
217. Fryer, i, p. 302.
218. *The Book of Ser Marco Polo*, tr. and ed. Col. Yule, ii, p. 389.
219. Varthema, p. 277.
220. Qaisar, 'Merchant Shipping etc.', p. 198 and n. 5.
221. Cf. Elliot, *History of India etc.*, vi, app. A, pp. 480–2; for Oppert and others, see G. N. Vaidya, 'Fire-arms in Ancient India', *RAS* (Bombay), new series, iii–iv, 1927–8, pp. 27–38. Also, R. Maclagan, 'On Early Asiatic Fire-weapons', *JAS* (Bengal), xlv, pt i, 1876, pp. 30–71.
222. Cf. Vaidya; R. Maclagan; P. C. Ray, *History of Chemistry in Ancient and Medieval India*, ed. P. Ray, pp. 225–6; Lallanji Gopal, 'The *Sukranīti*—a Nineteenth Century text', *Bulletin of the SOAS*, xxv, 1962, pp. 524–56. See also P. K. Gode's three articles: (a) 'Use of Guns and Gunpowder in India', (b) 'The Manufacture of Fire-arms in India', (c) 'The History of Fire-works in India between A.D. 1400 and 1900'.
223. M. Akram Makhdoomee, 'Gunpowder Artillery in the Reign of Sultan Eltutmish of Delhi', *JIH*, xv, 1936, p. 186. Abu Zafar Nadvi ('The Use of Cannon in Muslim India', *IC*, xii, no. 4, 1938, p. 405) traces the use of cannon to 'Alā'uddīn Khaljī in A.D. 1299–1300. Yar Muhammad Khan ('The Use of Artillery during the Sultanate Period', *IC*, xxxv, no. 3, July 1961, pp. 198–203) first states that the use of cannon and guns was frequent in northern India in the second half of the fourteenth century (p. 201), but concludes at

the end (p. 203) that use of rockets and guns was made in the latter part of the fifteenth century and the early part of the sixteenth century.

224. Iqtidar Alam Khan, 'Origin and Development of Gunpowder Technology in India, 1250–1500', *IHR*, iv, no. 1, July 1977, pp. 20–9.
225. I. A. Khan, 'Early use of Cannon and Musket in India, A.D. 1442–1526' (paper read at the Hyderabad Session, *IHC*, Dec. 1978). Also see Gode, 'The Manufacture and use of Fire-arms in India'. Compare, however, J. N. Sarkar, *Military History of India*, pp. 50, 56, where he says that fire-arms before Bābur were unknown in North Indian warfare.
226. Cf. Whiteway, p. 37.
227. Ibid.
228. Varthema, p. 262.
229. Whiteway, p. 37.
230. Varthema, p. 281.
231. Bernier, p. 217; also Careri in the *Indian Travels of Thévenot and Careri*, tr. and ed. S. N. Sen, p. 244.
232. *Tuzuk*, p. 359. His real European nationality is not known. Whatever it was, he seems to have been converted to Islam.
233. Careri, pp. 217, 218. Also see Tavernier, i, p. 59.
234. Tavernier, i, p. 284. Also ibid., p. 288.
235. Manucci, i, pp. 93, 95.
236. Ovington, p. 94.
237. Burnell, p. 19.
238. Ibid., pp. 140–1.
239. Fryer, i, p. 223.
240. Bernier, p. 31.
241. Bowrey, p. 111.
242. Manucci, i, p. 226.
243. Tavernier, i, p. 129.
244. Bernier, p. 217.
245. Fryer, ii, p. 112.
246. Careri, p. 244.
247. Bowrey, p. 111.
248. Manucci, i, p. 95.
249. Careri, p. 218.
250. Manucci, i, p. 95.
251. *EF*, 1665–7, p. 166.
252. Bernier, p. 217.
253. Thévenot in *The Indian Travels of Thévenot and Careri*, tr. and ed. S. N. Sen, p. 390.
254. Tavernier, ii, pp. 289–90.
255. Manucci, ii, p. 87; *EF*, 1660–4, p. 294. Pratt also made swivel guns.
256. *EF*, 1665–7, p. 165.
257. Burnell, pp. 143–4.
258. *EF*, 1618–21, p. 92, n. 2.
259. *EF*, 1642–5, p. 148.
260. Ibid., 1646–50, pp. 166, 213, 250, 254, 257; 1655–60, pp. 10, 92, 166, 169, 212, 264 and n. 1.

261. Ibid., 1665–7, pp. 165–6. Apart from guns, shot also was procured from the English by the Surat authorities (cf. *EF*, 1618–21, p. 238). Shot was made by the English in large quantities at Surat in 1625 (cf. ibid., pp. 73, 85).
262. Viscount Montgomery, *A History of Warfare*, p. 216; also, Jaroslav Lugs, *Firearms, Past and Present*, i, pp. 14–16.
263. Manrique, ii, p. 227.
264. Ibid., p. 125.
265. *EF*, 1621–3, p. 72.
266. Manrique, ii, pp. 125, 227.
267. Ibid., p. 234.
268. R. W. Latham, *Antique Guns in Colour*, p. 18. Also, Nicholas du Quesne-Bird, *Firearms*, p. 55.
269. Pyrard, ii, pt ii, pp. 379–80.
269a. For a pictorial depiction of muzzle-loading during Jahāngīr's time, see M. Goedhuis, *Imperial Painting*, Pl. 16: 'Jahāngīr Hunting Lions from Elephant' (right corner, below).
270. *Ā'īn*, ii, p. 125.
271. Maurice Daumas (ed.), *A History of Technology and Invention*, ii, pp. 488–9.
272. Manrique, ii, p. 125.
273. *The Travels of Pietro Della Valle*, ii, pp. 371–2. Cf. the view of Irfan Habib, 'Technology and Economy etc.', pp. 23–4.
274. Cf. Montgomery, pp. 231–2; also see Daumas, p. 491.
275. Latham, pp. 34–5.
276. Bernier, p. 254.
277. Ibid.
278. Tavernier, i, p. 157.
279. Montgomery, p. 231. Also, Latham, p. 22.
280. Latham, p. 25.
281. Arnold and Wilkinson, *The Library of Chester Beatty etc.*, Pl. 78 (b): 'Jahāngīr [?] Taking Aim.'
282. Latham, p. 24 (sketches).-Bernier, p. 217, for 'squatting' position.
283. Bernier, p. 217. Careri, p. 244, where he paraphrases Bernier, and adds that 'they make but ill use of the rests'.
284. Cf. BM (OA): Mughal Painting, no. 1974 6–17 021 (50). Arnold and Wilkinson, iii, Pl. 90: 'Aurangzeb [?] Shooting *Nīlgā'is*.' D. Barrett and Basil Gray, *Painting of India*, p. 113: 'Shāh Jahān Hunting Deer.'
285. See Rai Krishnadasa, *Mughal Miniatures*, Pl. 9.
286. See, for example, the *Akbarnāma* illustrations, vol. i, no. 74/117 (Victoria and Albert Museum).
287. Lugs, i, p. 24. Also Montgomery, pp. 231–2.
288. W. Irvine, *The Army of the Indian Moghuls*, p. 111.
289. Cf. Hawkins in *Early Travels*, p. 76.
290. *EF*, 1630–3, pp. 281–2.
291. S. Commissariat, *Mandelslo's Travels in Western India*, p. 45.
292. Manrique, ii, p. 125.
293. Manucci, i, p. 344.
294. Ibid., pp. 348–9.

295. Tavernier, i, p. 130.
296. Ibid., p. 273.
297. *EF*, 1678–84, p. 310.
298. *EF*, 1665–7, p. 224.
299. Ibid., p. 190. The English kept six cases of pistols in the Bombay fort. Also Burnell, p. 53.
300. Burnell, p. 146.
301. Thévenot, p. 61. Careri merely repeats Thévenot (see p. 242).
302. Manrique, ii, p. 227.
303. R. S. Whiteway, *The Rise of the Portuguese Power in India, 1497–1550*, p. 41.
304. Manrique, ii, p. 228.
305. Cf. *EF*, 1646–50, pp. 250, 256.
306. Ibid., 1655–60, p. 159.
307. Ibid., 1665–7, p. 166.
308. Burnell, pp. 143–4.
309. Cf. Irfan Habib, 'Technology and Economy etc.', p. 27. Also *EF*, 1655–60, p. 279 n.; Bernier, p. 48; Irvine, pp. 147–51.
310. Terry, p. 314.
311. *EF*, 1622–3, p. 336.
312. *EF*, 1624–9, p. 309. However, in times of emergency, the English purchased locally manufactured powder. In 1625, they decided to buy 1,200 mds. at Ahmadābād (cf. *EF*, 1624–9, p. 73).
313. Manrique, ii, p. 227.
314. Cf. H. A. Young, *The East India Company's Arsenals and Manufactories*, p. 65.
315. Ibid., p. 69.
316. Ibid., pp. 63–4. For a detailed powder-making process, see *Dastūr-ul Saīd* (A.D. 1672), BM Or. 6962, ff. 84b–85b. Also see Bayāz-i Khushbū'i (Shāh Jahān's reign), I.O. 828, ff. 139b–41a.
317. Cf. Young, p. 63.
318. Ibid., pp. 64, 66, 71, 72, 80.
319. Ibid., pp. 64, 66, 81.
320. Ibid., pp. 68, 85, 114–15.
321. Ibid., pp. 67, 68–9, 84, 97, 115.
322. Farewell's account in the *Voyage of Downton*, p. 165.
323. *Letters Received by the East India Company from its Servants in the East, 1602–17*, ed. Danvers and Foster (henceforth *Letters Received*), i, p. 239; ii, p. 301.
324. Terry, p. 314.
325. *Letters Received*, iii, p. 9.
326. Terry, p. 314.
327. Thévenot, p. 61.
328. Tavernier, i, p. 83.
329. Ibid., p. 157.
330. See Forbes, *Oriental Memoirs*, i, p. 337 (cited in Fryer, i, p. 336, n. 1).
331. Cf. P. S. Rawson, *The Indian Sword*, pp. 45, 47, 48.
332. Olafsson, ii, 145.
333. Fryer, i, p. 336.
334. Rawson, p. 23.

335. Ibid.
336. For some European notices of Chinese printing methods, see *Purchas*, xv, pp. 386, 418–19.
337. Cf. D. C. Sen, *History of Bengali Language and Literature*, Calcutta, 1911, p. 849 (cited by L. Cardon and H. Hosten, 'Earliest Jesuit Printing in India', *JAS* (Bengal), n.s., ix, March 1913, p. 149 and n. 2.
338. For the development of printing in Europe, see S. H. Steinberg, *Five Hundred Years of Printing*, 3rd ed., 1977.
339. See Cardon and Hosten, p. 153. Cf. A. K. Priolkar, *The Printing Press in India*, pp. 2–9 (also, by the same author, *Goa Re-discovered*, p. 78).
340. Priolkar, *Goa Re-discovered*, pp. 62, 63, 78.
341. Cardon and Hosten, p. 164. Also Priolkar, *The Printing Press etc.*, pp. 9–11 (also Pls. 12 and 13).
342. Priolkar, *Goa Re-discovered*, p. 78.
343. See Cardon and Hosten, pp. 159, 160, 161. Also see Priolkar, *The Printing Press etc.*, p. 12.
344. Priolkar, *The Printing Press etc.*, pp. 13–14.
345. Cf. Priolkar, *Goa Re-discovered*, pp. 66–7.
346. Priolkar, *The Printing Press etc.*, pp. 7, 8.
347. Cf. ibid, p. 33.
348. Francis Goldie, *First Christian Missions to the Great Mogul*, p. 63; also, E. Maclagan, p. 191.
349. Warren Chappell, *A History of the Printed Word*, p. 106.
350. For details of such books, E. Maclagan, pp. 191–2.
351. See M. A. Alvi and A. Rahman, *Fathullah Shirazi—A Sixteenth Century Indian Scientist.*
352. E. Maclagan, pp. 211, 215.
353. Berry and Poole, *Annals of Printing*, p. 112.
354. E. Maclagan, pp. 208–9.
355. Ibid., pp. 192–3.
356. *EF*, 1655–60, p. 324, n. 1; 1660–4, p. 212; 1665–7, p. 162.
357. Cf. D. B. Updike, *Printing Types*, ii, p. 98.
358. *EF*, 1660–4, p. 212.
359. I.O., *Home Correspondence*, E/3/31, letter no. 3538.
360. Cf. E. B. Sainsbury, *A Calendar of the Court Minutes, etc. of the East India Company, 1674–1676*, p. 36.
361. Ibid., p. 37.
362. Ibid.
362a. Cf. I.O., *Bombay Consultations*, G/3/2, 30 June 1675, f. 91.
363. I.O., *Surat*, E/3/37, O.C. 4258, f. 32.
364. I.O., *Surat*, G/36/89, Swally Marine letter, ff. 22–3.
365. Cf. Updike, i, pp. 5–9; ii, pp. 88, 92–5.
366. *EF*, 1670–6, p. 274.
367. Cf. Updike, ii, p. 98.
368. Ibid., pp. 94–5.
369. Ibid., pp. 95–6.
370. Berry and Poole, *Annals of Printing*, p. 79.
371. Ibid., p. 84.

372. Ibid., p. 112.
373. Ibid.; W. G. Hellinga, *Copy and Print in the Netherlands*, p. 30.
374. Cf. E. Maclagan, p. 204.
375. Ovington, p. 149.
376. Chappell p. 112.
377. Cf. *Bāburnāma*, tr. A. S. Beveridge, ii, p. 516.
378. Cf. J. F. Fleet, 'The Ancient Indian Water-clock', *JRAS*, 1915, p. 214.
379. Needham, iii, p. 313.
380. 'Afīf, *Tārīkh-i Feroze Shāhī*, pp. 254–60.
381. See Otto Kurz, *European Clocks and Watches in the Near East*, p. 4.
381a. 'Afīf, pp. 254–60.
382. *Sīrat-i Feroze Shāhī*, f. 153a.
383. *Bāburnāma*, ii, pp. 516–17; *Ā'īn*, iii, pp. 9–10; Mundy, ii, p. 167; Bowrey, pp. 195–7; John Marshall, p. 261; Sujān Rā'i, *Khulāsat-ut Tawārīkh*, p. 17; P. Acharya, 'Bruton's Account of Cuttack and Puri', *OHRJ*, x, no. 3, 1961, p. 35.
384. The diameter of the orifice had to be so narrow that it just allowed to pass through it a golden pin of one *māsha* by weight drawn into a length of five fingers (cf. *Ā'īn*, iii, p. 10; for ancient India, see Fleet).
385. Fleet, p. 214.
386. Terry wrote: '. . . measured to the ancient custome by water dropping out of one little vessell into another, by which there always stand servants appointed for that purpose.' In the 1655 edition of his travels, he added: 'To turn that vessell up again when it is all dropped out . . .' (cf. *Early Travels*, p. 317 and n.).
387. Fryer says in 1672: 'They have no watches or Hour-glasses, but measure time by the dropping of water out of a Brass Bason . . .' (ii, p. 92).
388. Cf. Kurz, p. 3.
389. St. Francis Xavier is reported to have presented a clock to the Japanese ruler in 1550 (cf. Sarton, *Introduction to the History of Science*, iii, pt ii, p. 1546). We may fairly infer that such clocks were used by the Portuguese in their Indian settlements.
390. Abul Fazl, *Akbarnāma*, iii, pp. 146, 228.
391. *A Supplementary Calendar etc.*, p. 35.
392. *Letters Received*, ii, p. 108. Its cost was £100.
393. Roe, p. 115 n.
394. Cf. Otto Kurz, p. 64.
395. See *Tuzuk-i Jahāngīrī*.
396. W. Noel Sainsbury (ed.), *Calendar of State Papers, 1617–21*, p. 120. Also see Otto Kurz, p. 64.
397. *EF*, 1646–50, p. 338.
398. Tavernier, i, p. 130.
399. Ibid., p. 140.
400. Bernier, pp. 177, 287.
401. *EF*, 1665–7, p. 309.
402. Abbé Carré carried two watches, both of which he lost in the course of his travels (Abbé Carré, i, p. 302).
403. Ovington, p. 166.

404. Kurz, p. 63 (taken from J. Evelyn, *The Diary*, ed. E. S. de Beer, 1953, iv, p. 358).
405. *Letters Received*, iii, p. 88.
406. Cf. Sarton, p. 1547.
407. See *Bāburnāma*, ii, pp. 516–17; *Ā'īn*, iii, p. 9; Terry, p. 317; Marshall, p. 281; Thévenot, pp. 139–40. Also see F. E. Pargiter, 'The Telling of Time in Ancient India', *JRAS*, 1915, pp. 699–715.
408. Cf. Needham, iv, pt ii, p. 439 and n. (e); p. 440 n. (a), p. 461.
409. Bowrey, pp. 196–7.
410. For the high cost of 'Larum watches', see Needham, iii, p. 330.
411. Cf. I.O. *Surat* G/36/5, f. 42 for two 'chests of clocks'; G/36/94, f. 21a (these two references relate to A.D. 1697 and 1694). Also see I.O. *Surat* G/36/9, 27 Feb. 1717.
412. Needham, iv, pt ii, p. 441 and n. (c).
413. W. B. Honey, *Glass—A Handbook and Guide etc.*, p. 1; Needham, iv, pt i, pp. 100–1.
414. See R. J. Forbes, *Studies in Ancient Technology*, v, pp. 118, 120, 122, 132.
415. M. G. Dikshit, *History of Indian Glass*, p. 2.
416. Vijay Govind, 'Some Aspects of Glass Manufacturing in Ancient India', *IJHS*, v, no. 2, Nov. 1970, p. 283.
417. Gode, 'The Use of *Kaca* or Glass in Indian Pharmacy', *Studies in Indian Cultural History*, iii, p. 89.
418. For such a caution, R. J. Forbes, p. 122.
419. Govind, p. 303.
420. Dikshit, p. 59 (also p. 147). Even as late as 1888, the manufacture of glass in India was considered to be 'in its most primitive state', and the articles made were 'chiefly' bangles and beads (cf. T. N. Mukharji, *Art-Manufacturers of India*, reprint, New Delhi, 1974, p. 294).
421. Dikshit, p. 39.
422. Even in the late nineteenth century, glass-blowers in Lahore used fragments of European glass (cf. G. Watt, *The Dictionary of Economic Products of India*, v, p. 504). Compare T. N. Mukharji, p. 294. Also see Anita Engle, *Readings in Glass History*, p. 124. In Persia, during the seventeenth century, glass-makers at Isfahan made glassware by remelting old glass (see Hans E. Wulff, *The Traditional Crafts of Persia*, p. 169).
423. For an integrated discussion on glass in ancient India, see Anita Engle, nos. 6–7, pp. 109–132.
424. Dikshit, pp. 25, 59, 63. For references to imports, see ibid., pp. 22, 25, 63, 65, 66, 67, 104 ff.
425. Ibid., pp. 59, 147.
426. Ibid., p. 66; Gode, 'The Use of *Kaca* etc.'
427. Cf. Gode, 'History of Glass-vessels and Glass-bangles in India, South Arabia and Central Asia', *Studies in Indian Cultural History*, iii, p. 88. Needham implicitly accepts this opinion (Needham, iv, pt i, p. 110). Also Anita Engle, p. 127.
428. Dikshit, p. 1.
429. *Ā'īn*, ii, pp. 416–77, 434, 442.
430. Gode, 'History of Glass etc.', p. 87.

431. Gode, 'The Use of *Kaca* etc.', p. 100. Also see Dikshit, p. 114.
432. For mirrors in ancient India, see Rajendralal Mitra, *Indo-Aryans etc.*, i, pp. 240–2; Moti Chandra, *Costumes, Textiles, Cosmetics and Coiffure in Ancient India*, pp. 185, 193, 215; M. K. Dhavalkar, *Ajanta—A Cultural Study*, pp. 89–90. I regret I have not seen K. de B. Codrington's article, 'Ancient Indian Hand-mirrors', in *Man*, xxix, 1929.
433. Cf. E. J. H. Mackay, *Further Excavations at Mohenjo-daro*, i, p. 477 (also ibid., ii, Pls. cxiv, fig. 1; cxviii, fig. 10; cxxx, fig. 25; cxxxii, fig. 26; xxxii, fig. 24).
434. Ibid., i, p. 478.
435. A. Ghosh, *Ajanta Murals*, Pl. lxxxi (a mural from cave no. 17).
436. Dhavalkar, p. 90.
437. Cf. Mulk Raj Anand and Stella Kramrisch, *Homage to Khajuraho*, Pl. 12 (a sculpture from the Kandariya Mahadeva temple).
438. In the Sunga-Satvahana period, mirrors of copper are traceable (cf. Moti Chandra, *Costumes, Textiles, etc.*, p. 215).
439. Maurice Daumas (ed.), *A History of Technology and Invention*, i, Pl. 46: 'Sultān Sikandar Zul Qarnain being Shown the Method of Making Mirrors', *c.* A.D. 1590. Also reproduced in Niharranjan Ray, *Mughal Court Paintings etc.*, Pl. v. The author of *Tabaqāt-i Akbarī* (ii, *Bib. Indica*, p. 457), without giving any details, mentions a mirror contrived by Fathullāh Shīrāzī (1580s) which, as he says, reflected 'strange figures from far and near'. Possibly this might have been either a concave or convex mirror producing distorted images. There is no evidence to infer that this mirror was made of glass.
440. Cf. Honey, p. 7.
441. Finch in *Early Travels*, p. 164.
442. See *Letters Received*, ii, p. 143; *A Supplementary Calendar etc.*, p. 83.
443. *A Supplementary Calendar etc.*, p. 41.
444. *EF*, 1618–21, pp. 64, 164.
445. Ibid., pp. 246, 327.
446. Ibid., 1624–9, p. 275.
447. Ibid., 1651–4, p. 85.
448. Ibid., 1668–9, p. 171.
449. Bernier, p. 292. Also see Pelsaert, 'Remonstrantie', tr. Moreland and Geyl as *Jahangir's India*, p. 27.
450. For gifts to Aurangzeb from the Dutch, see Bernier, p. 128.
451. Marshall, p. 399. Polishing was done in ancient India with 'fine soft red powder', that is, *gairika* = red ochre (cf. T. W. Rhys Davids, *The Questions of King Milinda*, i, p. 189; I owe this information to my friend, S. R. Sharma, Department of Sanskrit, Aligarh Muslim University). We do not know whether *gairika* was used for steel mirrors during the seventeenth century.
452. Burnell, p. 97.
453. Cf. I.O., *Surat Letters*, G/36/8, 17 Oct. 1702, p. 499.
454. Ibid., 24 Oct. 1702, p. 508.
455. Ibid., July 1702, pp. 841–2.
456. Ibid., p. 845.
457. Ibid., cf. *Patna Diary*, G/28/1, 27 Aug. 1683.
458. Ibid., 3 Sept. 1683.
459. Ibid., 24 Sept. 1683.

460. Ibid.
461. See E. Godfrey, pp. 251–2.
462. See an illustration in the *Khamsa* (BM Or. 12208), f. 206a (Mughal, *c.* A.D. 1595); *Jawāhir al-Musiqāt-i Muhammadī* (BM Or. 12857), f. 92a: 'Bhopal ragini' (1625–55); *Artibus Asiae, Supplementum xxxii* (*Rajput Paintings at Bundi and Kota*), fig. 32: 'Vilaval ragini (Bundi, *c.* A.D. 1680); L. Hajek, *Miniatures from the East*, Pl. 8: 'Gunakari ragini' (Mewar, 1700); also see A. A. Ivanova *et al.*, *Album of Indian and Persian Miniatures—xvi–xviii Centuries*, Pl. 69: 'A Girl Looking into a Mirror' (seventeenth century).
463. Cf. Hajek, *Miniatures from the East*, Pl. 23: 'Bilawal ragini' (Rajasthan, 1750); R. Reiff, *Indian Miniatures*, Pl. 4: 'Toilette of Radha' (Kangra, 1800); *Dīwān-i Hāfiz* (BM Add. 7763), f. 16b (Kashmir, eighteenth century); *Artibus Asiae, Supplementum xxxii*, fig. 94: 'Ram Singh II of Kota Watching a Bather' (Kota, *c.* 1828).

    A miniature from Rajasthan (Reiff, Pl. 3: 'Bilawal ragini') showing the rectangular looking-glass has been dated as 'second half of the seventeenth century'. The dating seems to be doubtful: perhaps it should belong to the early eighteenth century.
464. Cf. James Skinner, *Tashrīh-al Aqwām*, Add. 27,555, f. 211b.
464a. Cf. Ānand Ram Mukhlis, *Mir'āt-al istilāh*, BM Or. 1813, s.v. *ā'īna-tasweer* and *ā'īna-i do rū*.
465. See Watters (tr.), *Travels*, p. 178.
466. Gode, 'Some Notes on the Invention of Spectacles and the History of Spectacles', *Studies in Indian Cultural History*, iii, pp. 106–7.
467. Cf. *The Commentary of Father Monserrate*, p. 193.
468. *A Supplementary Calendar etc.*, p. 83.
469. *EF*, 1624–9, p. 93.
470. See Shaikh Farīd Bhakkarī, *Zakhīrat-al Khawānīn* (3 vols.); also, Shah Nawaz Khan, *Mā'asir-al Umara'* (3 vols.).
471. Careri, p. 221.
472. *The Travels of Pietro Della Valle in India*, ed. E. Grey, i, p. 68.
473. A. A. Ivanova *et al.*, Pl.23 (upper part): 'Poetry Recital' (first quarter of the seventeenth century); Kuhnel and Goetz, *Indian Book Paintings*, Pl. 39: 'A Painter' (early seventeenth century); I. Stchoukine, *Les Miniatures Indiennes de l'Epoque des Grands Moghols etc*, Pl. 2(a): 'Mīr Musavvir' (second half of the sixteenth century); B. W. Robinson *et al.*, *Islamic Painting and the Arts of the Book*, Pl. 117; 'Portrait of an Artist' (A.D. 1600); L. Hajek, *Indian Miniatures of the Moghul School*, Pl. 33: 'A Poet' (early seventeenth century).
474. I.O., *Patna Diary*, G/28/1, 3 July 1683; 24 July 1683; 27 Aug. 1683; 2 Sept. 1683.
475. Ibid., 27 Aug. 1683.
476. Ibid.
477. Ibid., 27 Sept. 1684.
478. *The Oriental Miscellany*, pp. 138, 206.
479. Cf. the *Akbarnāma* illustration, no. 80/117 (Victoria and Albert Museum): 'Birth of a Prince'; also, an illustration from *Akbarnāma* (vol. i, BM), f. 34b: 'Birth of Timur.' Hajek, *Indian Miniatures of the Moghul School*, Pl. 18: 'Astrologer with Hour-glass, etc.' For a giant hour-glass with symbolic depiction,

see R. Ettinghausen, *Paintings of the Sultans and Emperors of India*, Pl. 14: 'Jahāngīr Preferring a Sūfī Shaikh to Kings' (A.D. 1625).

480. Manucci, vol. ii, p. 70. Thus Bowrey is not altogether right when he says that the Indians did not use hour-glasses (cf. Bowrey, p. 195).
481. John Marshall, p. 281.
482. Cf. *EF*, 1646–50, p. 106.
483. Godfrey, p. 232.
484. Leigh Ashton, *The Art of India and Pakistan*, pp. 232, 233 (nos. 1236, 1236(b), and 1237). Also see Dikshit.
485. Honey, p. 70.
485a. Marshall, p. 121.
485b. Cf. Levon Khachikian, 'The Ledger of the Merchant Hovhannes Joughayetsi', *JAS(B)*, viii, no. 3, 1966, pp. 162, 164.
485c. Ānand Rām Mukhlis, *Mir'āt-al istilāh*, BM Or. 1813, s.v. *bāda-i Shīrāz*.
486. Cf. I.O., *Surat Letters*, G/36/8, July 1703, pp. 841–6.
487. Ibid., 10 Nov. 1702, p. 532.
488. I.O., *Surat*, G/36/5, 26 July 1697, f. 88.
489. I.O., *Surat*, G/36/8, July 1703, pp. 841–6.
490. Ibid.
491. For sale of drinking-glasses, see I.O., *Surat Consultations*, G/36/5, 29 July 1707, ff. 52–3; ibid., 4 May 1708, f. 65.

    For gifts, see I.O., *Patna Diary*, G/28/1, 5 June 1683. For multiplying glasses, see *Patna Diary*, 3 July 1683; 24 July 1683. For burning glasses, see ibid., 3 July 1683; 24 July 1683. For prospective glasses, see *Patna Diary*, 3 July 1683; 27 Sept. 1684; *Surat Letters*, G/336/8, July 1703.
492. *Surat Consultations*, G/36/5, 29 July 1707, ff. 52–3.
493. Cf. Sujān Rā'i, p. 75.
494. Methwold in *Relations of Golconda*, pp. 30–3.
495. Irfan Habib, 'Technology and Economy etc.', p. 31.
496. See above, n. 494.
497. Careri, p. 251.
498. *The Diaries of Streynsham Master*, ed. R. C. Temple, ii, p. 174.
499. Fryer, i, p. 285.
500. Tavernier, ii, p. 58.
501. Ralph Fitch in *Early Travels*, p. 18.
502. *Tuzuk*, pp. 266, 267.
503. Manucci, i, pp. 237–8; cf. Tavernier, i, p. 396.
504. Tavernier, ii, pp. 56–9.
505. Fryer, i, pp. 284–5.
506. Thévenot, p. 138.
507. Tavernier, ii, p. 58.
508. Ibid., pp. 58–9.
509. Ibid., p. 56.
510. Thévenot, p. 138.
511. Cf. Hajek, *Indian Miniatures of the Moghul School*, Pl. 16. For the earliest pictorial depiction of the bow-drill, see *Miftāh-ul Fuzalā'*, f. 161b. For the use of another device, that is, belt-drive, see Fryer, i, p. 285. There is no evidence that Indians adopted this from Europe.

512. Cf. Rich and Wilson, *The Cambridge Economic History of Europe*, iv, p. 105.
513. The Rev. Patrick Copland's narrative in *The Voyage of Thomas Best*, ed. W. Foster, p. 208.
514. *EF*, 1642–5, p. 183.
515. Ibid., 1665–7, p. 385.
516. Ibid., p. 108.
517. Ovington, p. 183.
518. *EF*, 1670–7, p. 10.
519. Ibid., 1634–40, p. 44.
520. See Irfan Habib, 'Technology and Economy etc.', p. 30.
521. Cf. Rich and Wilson; also, Christopher Hill, *Reformation to Industrial Revolution*, p. 48.
522. See Pabitra Bhaskar Sinha, 'The Early History of the Coal Mining Industry in India, 1774–1833', *Bengal, Past and Present*, lxxxix, no. 107, Jan.–June, 1970, pp. 29–40.
523. *EF*, 1651–4, p. 95.
524. Susil Choudhury, *Trade and Commercial Organization in Bengal, 1650–1720 A.D.*, p. 162.
525. Tavernier, ii, p. 12. For the depot at Chapra, see p. 122.
526. *EF*, 1651–4, p. 95. Also N. N. Raye, *The Annals of the Early English Settlement in Bihar*, p. 52.
527. Cf. *EF*, 1618–21, p. 197; 1630–3, p. 124; 1646–50, pp. 78, 161, 190, 255–6; 1655–60, p. 241; 1661–4, pp. 208–9; 1668–9, p. 310; 1670–7, p. 110.
528. For this view, see K. N. Chaudhuri, 'The Structure of Indian Textile Industry in the Seventeenth and Eighteenth Centuries', *IESHR*, ix, 1974, p. 129. Also, cf. Irfan Habib, 'Indian Textile Industry in the Seventeenth Century', *Essays in Honour of Professor S. C. Sarkar*, Delhi, 1976, pp. 181–92, for not taking any notice of the introduction of European textile technology into India since there was none.
529. V. Slomann, *Bizarre Designs in Silks*, pp. 110–11.
530. Ibid.
531. Bowrey, p. 215, n. 1.
532. Ibid., p. 214, n. 2.
533. Ibid., p. 214.
534. Slomann, p. 11 and n. 2.

Chapter III PAINTINGS, ARCHITECTURE AND MUSIC

1. J. V. S. Wilkinson, *Mughal Painting*, p. 2.
2. F. R. Martin, *The Miniature Painting and Painters of Persia, India and Turkey*, i, p. 79.
3. Laurence Binyon, *The Spirit of Man in Asian Art*, pp. 136–7.
4. Ibid., p. 137. Also see L. Binyon and T. W. Arnold, *The Court Painters of the Grand Moguls*, p. 37.
5. Cf. Richard Winstedt (ed.), *Indian Art*, p. 129.
6. Anis Farooqi, 'The Establishment of Akbar's Atelier', *Indica*, ii, no. 1, March 1974, p. 40; also see Lubor Hajek, *Indian Miniatures of the Moghul School*, p. 49.

7. Abul Fazl, *Ā'īn-i Akbarī*, i, p. 117.
8. Cf. Stuart C. Welch, *The Art of Mughal India*, p. 29.
9. Abul Fazl, *Akbarnāma*, iii, p. 27; Francis Goldie, *First Christian Missions to the Great Mogul*, pp. 55–6; Edward Maclagan, *The Jesuits and the Great Mogul*, pp. 23–4.
10. The first Jesuit Mission at Fathpūr Sīkrī learnt that Akbar had already put up pictures of Christ, Mary and Moses in his dining room (cf. Winstedt, p. 130).
11. Percy Brown, *Indian Painting under the Mughals*, p. 167; L. Binyon, p. 137; Winstedt, p. 130.
12. E. Maclagan, p. 191.
13. Ibid., pp. 191–2.
14. Ibid., pp. 225–6.
15. Ibid., pp. 226–7.
16. *The Voyage of Nicholas Downton to the East Indies, 1614–15*, p. 187.
17. *The Voyage of Thomas Best*, ed. W. Foster, p. 244.
18. *The Embassy of Sir Thomas Roe to the Great Mogul, 1615–1619*, ed. W. Foster, p. 119.
19. Ibid., p. 488.
20. *Voyage of Downton*, p. xii.
21. *The English Factories in India, 1618–69*, ed. W. Foster, 13 vols. (henceforth *EF*), 1618–21, p. 111 (also see pp. 38, 54).
22. For a different view, see E. Maclagan, p. 227. See also Martin, i, p. 85.
23. C. H. Payne, *Jahangir and the Jesuits*, p. 170.

23a. C. H. Payne, *Akbar and the Jesuits*, p. 158.

24. *Voyage of Downton*, pp. 8, 89.
25. Roe, p. 245.
26. Ibid.
27. E. Maclagan, pp. 224–5.
28. *Voyage of Downton*, pp. 8, 89.
29. Goldie, pp. 68–9.
30. Payne, *Akbar and the Jesuits*, ch. xvi.
31. Ibid., p. 163.
32. E. Maclagan, p. 234.
33. H. Goetz, 'Masterpieces of Mogul Painting', *Marg*, vi, no. 2, p. 43.
34. Pelsaert, 'Remonstrantie', tr. W. H. Moreland and P. Geyl as *Jahangir's India*, p. 25.
35. *EF*, 1618–21, pp. 38, 54.
36. Ibid., p. 266.
37. Ibid., p. 54.
38. T. W. Arnold and J. V. S. Wilkinson, *The Library of Chester Beatty: Catalogue of the Indian Miniatures*, iii, Pl. 77.
39. Āsaf Khān's palace at Lahore had wall-paintings of St. John the Baptist and Noah (cf. F. S. Manrique, *Travels, 1629–43*, tr. C. E. Luard, ii, p. 207).
40. *Voyage of Downton*, p. 8; also Leigh Ashton, *The Art of India and Pakistan*, no. 751 (1).
41. Cf. V & A, Clive Album, f. 7b.
42. B. W. Robinson *et al.*, *Islamic Painting and the Arts of the Book* (The Keir Collection), Pl. 122.

43. Cf. E. Maclagan, p. 254. See Chandramani Singh, 'European Themes in Early Mughal Miniatures', *Chhavi*, Golden Jubilee Volume, Bharat Kala Bhavan, 1971, fig. 592 and fig. 593.
44. See Milo Cleveland Beach, 'The Gulshan Album and its European Sources', *BBMFA*, vol. lxiii, no. 332, 1965, fig. 12a. For the early eighteenth century, BM (OA) 1936 1–11 063.
45. See app. A (i) for selected references. For a general reference, cf. E. Maclagan, pp. 236, 249, 250–4. Also see Ashok Kumar Das, *Mughal Painting during Jahangir's Time*, ch. 10, pp. 229–49.
46. E. Maclagan, p. 254.
47. Marmaduke Pickthall, *The Meaning of Glorious Qur'ān, Text and Explanatory Translation*, Taj Company, Karachi, n.d., *surah* iv, verses 157–8. Also *surah* iii, verses 54–5.
48. Ibid., *surah* v, verse 42.
49. T. W. Arnold, *Painting in Islam: Study of the Place of Pictorial Art in Muslim Culture*, p. 7 and n. 2.
50. See app. A (ii).
51. BM (OA) 1920 9–17 032: 'Christ Stilling the Storm'; V & A, Clive Album, f. 8a: 'Widow's Dead Son Regains Life'; V & A, D. 132–1885 (28): 'Curing of the Daughter of Jarius'.
52. Cf. (I.O.) Johnson, 16.1; 'The Good Shepherd'; V & A, D. 132–1885 (25): '*La parabole de l'juraye*'.
53. E. Maclagan, p. 255. Cf. Leigh Ashton, Pl. 128, no. 665: 'St. John'; A. A. Ivanova *et al.*, *Album of Indian and Persian Miniatures, xvi–xviii Centuries*, Pl. 50 (upper part, central figure): 'St. George'; I. Stchoukine, *La Peinture Indienne a l'Epoque des Grands Moghols*, Pl. xix B: 'St. Matthew'; Milo C. Beach, fig. 10d: 'St. Jerome'; V & A, IM 139–1921: 'Martyrdom of St. Cecilia'; (I.O.) Johnson, 14.6: 'Mary Magdalene'; V & A, IM 284–1913: 'St. Catherine of Alexandria'; (I.O.) Dārā Shukoh's Album, 43 recto: 'St. Margaret and St. Catherine of Siena'.
54. See app. A (iii).
55. Roe, pp. 386–7, 387 (n. 1).
56. Ivanova *et al.*, Pl. 13: 'Allegorical Figure'; Pl. 20: 'Arithmetika'; Pl. 12: 'Dialectic'; V & A, Clive Album, f. 9(b): 'Sight'; f. 10(a): 'Summer'; f. 11(b): 'Autumn'; f. 12(a): 'Winter'. For other examples, see Beach, fig. 1 (five engravings forming the left border relating partly to the 'Seven Cardinal Virtues').
57. Roe, pp. 386–7; Manrique, ii, pp. 143, 394; V. E. Kuhnel and H. Goetz, *Indian Book Painting*, p. 64. Also see BM (OA) 1954 5–8 02: 'A Caprice: Portrait of Francis, Dauphin of France'; (I.O.) Johnson, 22.2: 'Lord Edmond of Malgrave'; V & A, IM 8–1913: 'Portrait of Lady Shirley'.
58. Pelsaert, p. 26.
59. See *EF*, 1618–21, pp. 54, 111.
60. See app. A (iv).
61. Hajek, *Indian Miniatures of the Moghul School*, pp. 49–50.
62. This passage is based on a number of sources. Cf. Wilkinson, p. 3; Binyon, pp. 121–3; S. C. Welch, *The Art of Mughal India*, pp. 29–30; Binyon and Arnold, p. 48; W. E. G. Solomon, *Essays on Mughal Art*, pp. 37–8; E. M.

Gombrich, *The Story of Art*, pp. 172, 183, 214; E. MacCurthy, *The Notebooks of Leonardo da Vinci*, ii, pp. 220, 222–3, 237, 337–54.

63. E. B. Havell, *The Art Heritage of India*, p. 95.
64. Brown, p. 141.
65. Benjamin Rowland, Jr., *Art in East and West*, pp. 30–2, 38.
66. Ibid., p. 8.
67. Homi J. Bhabha, 'Leonardo da Vinci', *Marg*, v, no. 4.
68. Gombrich, p. 214.
69. Payne, *Akbar and the Jesuits*, pp. 168–9.
70. Cf. Brown, pp. 167–8; Smith, *History of Fine Arts in India and Ceylon*, p. 72.
71. E. Maclagan, p. 227.
72. Payne, *Jahangir and the Jesuits*, pp. 63–5.
73. S. C. Welch, *The Art of Mughal India*, p. 29. For some examples, compare Arnold and Wilkinson, iii, Pl. 77: 'Adam'; I. Stchoukine, *La Peinture Indienne etc.*, Pl. xix B: 'St. Matthew'; Kuhnel and Goetz, Pl. 42: 'Madonna and Child'; Pl. 41: 'Holy Family'; (I.O.) Johnson, 14.5a: 'A Kneeling Saint'.
74. Roe, pp. 225–6.
75. Ibid., pp. 255–6.
76. Cited in C. M. Birdwood, *The Industrial Arts of India*, p. 134. (This reference has been taken from the 1655 edition of Terry's travels.)
77. Martin, i, p. 85.
78. S. C. Welch, *The Art of Mughal India*, p. 29.
79. Cf. Kuhnel and Goetz, Pls. 29 and 30 (copies from Beham and Durer).
80. Binyon and Arnold, Pl. xviii: 'Dancing Darweshes'.
81. Compare the three shepherds with European iconography in Miskīn's painting of 'A Shepherd Boy Slain by a Shāh's Arrow' (S. C. Welch, Jr., 'The Paintings of Basawan', *Lalit Kala*, no. x, Oct. 1961, Pl. vii, fig. 16).
82. Cf. Hajek, *Indian Miniatures of the Moghul School*, Pl. 8. Also see two engravings in Kuhnel and Goetz, p. 42 (p. 8a), pasted on a border decoration.
83. Martin, i, p. 83; cf. S. C. Welch, *The Art of Mughal India*, p. 30 and Pl. 14: 'Christ with the Virgin and St. Anne'. Also see E. Maclagan, p. 252.
84. Cf. (I.O.) Johnson, 14.6: 'Magdalen [?] Praying'; Chandramani Singh, p. 408 and Pl. 36: 'Holy Virgin'; Crowe *et al.*, *The Gardens of Mughal India*, unnumbered plate between pp. 12–13: 'Two European Figures'.
85. See V & A, IM 284–1913: 'St. Catherine of Alexandria with Preceptors', V & A, D. 399–1881: 'A Drinking Scene'; (I.O.) Johnson, 16.6: 'European Reading a Book with Attendants Around'; I. Stchoukine, *Miniatures Indiennes de l'Epoque des Grands Moghuls au Musée du Louvre*, Pl. xl: 'Nativity'; Pl. xxxix: 'An Unhappy Lady'. Also see Ananda K. Coomaraswamy, *Catalogue of the Indian Collections in the Museum of Fine Arts*, pt vi, Pl. lxxxiii: 'Birth of a Child'.
86. Cf. Kuhnel, *Miniaturmalerei Im Islamischen Orient*, p. 114.
87. S. C. Welch, Jr., 'The Paintings of Basawan', p. 12.
88. Ananda Krishna, 'Tuti-nama', *Artibus Asiae*, xxxv, iii, pp. 261–2.
89. Stanley Clarke, *Indian Drawings: Thirty Mughal Paintings of the School of Jahangir*, Pl. 1: 'Mirza Kamran Meeting an Envoy near Kabul'.
90. I. Stchoukine, *Miniatures Indiennes etc.*, Pl. x: 'A Mulla on a Horse'; and Pl. vi, no. 41: 'Jahāngīr and Jadrūp Yogī'.

91. S. C. Welch, Jr., 'The Paintings of Basawan', p. 13 and Pl. ii, fig. 4.
92. Ibid., Pl. vii, fig. 16.
93. Arnold and Wilkinson, iii, Pl. 69; also, Binyon and Arnold, Pl. xvii: 'Shāh Jahān Visiting a Mulla'.
94. For example, cf. Arnold and Wilkinson, iii, Pl. 90.
95. Binyon and Arnold, p. 67. For examples, see V & A, *Akbarnāma*, i. IS 93/117: 'Akbar's Torchlight Inspection after the Chase'; P. Brown, Pl. li: 'Darweshes'.
96. Cf. Wilkinson, *Mughal Painting*, Pl. x.
97. Gombrich, pp. 72, 73, 75.
98. Ibid., p. 323.
99. Cf. K. Khandalavala and Moti Chandra, *Miniatures and Sculptures (from the Collections of Late Sir Cowasji Jahangir)*, no. 35: 'Darweshes by the Riverside'; Binyon and Arnold, Pl. xxxiv: 'Hunting by Night'; W. G. Archer, *Indian Miniatures*, Pl. 46: 'A Prince Receiving a Lady'.
100. Binyon, p. 138.
101. R. Winstedt, p. 50.
102. Cf. S. C. Welch, *Gods, Thrones and Peacocks*, Pl. 46: 'Lovers Strolling by a Pool'.
103. Hajek, *Indian Miniatures of the Moghul School*, p. 50.
104. Cf., for example, R. Winstedt, Pl. xi: 'Dārā Riding the Imperial Elephant'.
105. Brown, p. 159.
106. Cf. *Dārābnāma*, BM Or. 4615, f. 34a; also see S. C. Welch, Jr., 'The Paintings of Basawan', p. 12 and Pl. 1, fig. 2.
107. Cf. *Shāhnāma*, BM Add. 5600, f. 372a: 'Building activities'; A. A. Ivanova *et al.*, *Album of Indian and Persian Miniatures, xvi–xviii Centuries*, Pl. 23 (upper part, old man with spectacles); also see Arnold and Wilkinson, iii, Pl. 66: 'A Nobleman with His Attendants'.
108. Arnold and Wilkinson, iii, Pl. 60.
109. I. Stchoukine, *La Peinture Indienne etc.*, Pl. xliv. Also Arnold and Wilkinson, iii, frontispiece: 'A Rustic Scene' (by Govardhan). The bearded figures in both the paintings are, surprisingly, identical.
110. S. C. Welch, Jr., 'The Paintings of Basawan', Pl. vii, fig. 15; Pl. viii, fig. 18.
111. Arnold and Binyon, Pl. xxiv.
112. F. Bernier, *Travels in the Mogul Empire*, tr. A. Constable, p. 255.
113. Thévenot in *The Travels of Thévenot and Careri*, tr. and ed. S. N. Sen, p. 65.
114. Bernier, p. 339.
115. Brown, p. 173.
116. For Turkish examples, cf. Lillys *et al.*, *Oriental Miniatures*, Pl. i: 'Adam and Eve'; Pl. iv: 'The Nativity of Muhammad'; Pl. v: 'Muhammad on Mount Hira'; Pl. vi: 'Muhammad Praying with Khadīja and 'Alī'; Pl. vii: 'The Death of Muhammad'. For Persian examples, see P. Morand and G. Guillaume, *Chefs d'Oeuvre de la Miniature Persane*, Pl. 6: 'Le Paradis'; Pl. 12: 'Ascension de Mahomet'.
117. Cf. Brown, p. 173; also, Basil Gray, *The Treasures of Indian Miniatures*, p. 22.
118. Cf. Arnold and Wilkinson, iii, Pls. 57 and 63. For other examples of the halo, see R. Ettinghausen, *Paintings of Sultans and Emperors of India*, Pl. 13: 'Jahāngīr

Entertains Shāh 'Abbās'; Pl. 14: 'Jahāngīr Preferring a Sūfī Shaikh to Kings'; Pl. 12: 'Jahāngīr's Dream of Shāh 'Abbās'.

119. Cf. Morand and Guillaume, Pls. 6 and 12.
120. A wall-painting in the villa Farnesina, Rome, 1514 (cf. Gombrich, p. 235, illus. no. 197).
121. Cf. Ettinghausen, Pls. 12, 13 and 14. Arnold and Wilkinson, iii, Pls. 63 and 86. Also, Stchoukine, *La Peinture Indienne etc.*, Pls. xxxviii and xxxix.
122. See Arnold and Wilkinson, iii, Pls. 63 and 86. Also B. Gray, p. 22.
123. Brown, p. 177.
124. Cf. Ettinghausen, Pl. 7: 'The Rendering of Justice' (note the folds in the clothes of the old woman). Also see Wilkinson, *Mughal Paintings*, Pl. 4: 'Birth of Salīm'.
125. Martin, i, p. 87.
126. Gombrich, p. 77.
127. Ibid., p. 103.
128. Cf. E. B. Havell, p. 91.
129. For example, cf. S. Clarke, Pls. 12 and 17: 'Indian Fallow Deer and Tibetan Chiru'.
130. Cf. Wilkinson, Pl. 9: 'Shāh Jahān Visiting a Religious Teacher'.
131. BM (OA) 1974 6–17 021(50); ibid., 1920 9–17 01; D. Barrett and Basil Gray, *Painting of India*, p. 113: 'Shāh Jahān Hunting Deer'; Arnold and Wilkinson, iii, Pl. 90: 'Aurangzeb [?] Shooting *Nīlgā'is*'.
132. *Great Paintings from the Metropolitan Museum of Art*, no. 34.
133. BM (OA) 1942 1–24 03.
134. Ettinghausen, Pl. 14.
135. Arnold and Wilkinson, iii, Pl. 62.
136. Cf. Ettinghausen, Pls. 12 and 13.
137. Ibid., Pl. 12. Arnold and Wilkinson, iii, Pls. 57, 62, 63 and 86.
138. Ettinghausen, Pl. 14.
139. Brown, p. 156.
140. Martin, i, p. 86.
141. See, for example, Basil Gray, *Treasures etc.*, Pl. viii: 'Mahārāja Anūp Singh of Bīkāner'.
142. Brown, p. 157.
143. Ettinghausen, Introduction.
144. Cited in Brown, p. 157. The portrait of Nūr Jahān in Binyon and Arnold, Pl. xv, is extremely doubtful. For another figure of Nūr Jahān, see Stanley Clarke, Pl. 5: 'Nūr Jahān Entertaining Jahāngīr and Prince Khurram'.
145. Thévenot, p. 55.
146. Havell, Pl. G.
147. Cf. E. Panofsky, *Early Netherlandish Painting*, ii, Pl. 123: 'Lucca Madonna'; Pl. 170: 'Madonna Enthroned'; Pl. 171, no. 307: 'Madonna Standing'. Also see M. J. Friedlaender, *From Van Eyck to Bruegel*, Pls. 66, 82, 201 and 204.
148. Milo C. Beach, p. 86 and fig. 11b.
149. Cf. Gombrich, pp. 172–3, 183; also B. Rowland, Jr., p. 4.
150. Roe, p. 255.
151. Abul Fazl, *Ā'in-i Akbarī*, i, p. 116.
152. Cf. B. Rowland, Jr., p. 6.

153. 'They are much addicted to pictures, but nothing so cunning in painting, founding, engraving, as Europeans . . . Shadowes and Oyle in picturing are to them unknowne, and their pictures therefore have no more life of Art than Nature . . .' (cf. *Purchas His Pilgrimes*, p. 419). See also Binyon, *The Spirit of Man*, p. 138.
154. Cf. Boxer, *Jan Campagnie in Japan, 1600–1817*, p. 95.
155. Martin, i, p. 87.
156. For woodcut, Arnold and Wilkinson, iii, Pl. 77: 'Adam'. For copper, cf. Dārā Shukoh Album, 43 recto: 'St. Margaret and St. Catherine'; also (I.O.) Johnson, 14.5a; 'The Kneeling Saint'.
157. Cf. Gombrich, p. 204.
158. Thévenot, p. 65.
159. For example, Hajek, *Indian Miniatures of the Moghul School*, p. 50.
160. Cf. S. Kramrisch, *A Survey of Painting in the Deccan*, pp. 117, 143; D. Barrett, *Painting of the Deccan, xvi–xvii Century*, pp. 5, 24.
161. Cf. *Marg*, xvi, no. 2, March 1963, Pls. 3 and 6. Also Barrett, Pl. 10: 'A Prince in a Garden' (for adaptation of European costume by a page of the Prince).
162. Barrett, 'Some Unpublished Deccan Miniatures', *Lalit Kala*, no. 7, April 1960, Pl. iii, fig. 6.
163. Ibid. Also Khandalavala and Chandra, no. 59: 'A Prince Practising Archery'.
164. Cf. Kramrisch, pp. 143, 149, 158.
165. Cf. V & A, IM 293–1913: 'Two European Ladies'; V & A, IM 132–1885/30: 'Virgin and Child with Simon'; (I.O.) Johnson, 16.8: 'A European Holding a Wine Cup'; 14.6: 'Magdalen [?] Praying'.
166. Kramrisch, pp. 117–18.
167. Cf. Chandramani Singh, p. 402.
168. BM (OA) 1956 7–14 024: 'A Frenchman'; BM (OA) 1956 7–14 026: 'French Ladies in a Garden'; BM (OA) 1956 7–14 028: 'Woman in European Dress Feeding Pet Birds'.
169. J. Irwin, 'Golconda Cotton Paintings of the Early Seventeenth Century', *Lalit Kala*, no. 5, April 1959.
170. Cf. ibid., Pl. iv, fig. 4; Pl. iii, fig. 5; Pl. x, fig. 14.
171. Ibid., Pl. ii, fig. 2.
172. Ibid., Pl. xi, fig. 15. For such composite animals in ordinary paintings, see S. N. Gupta, *Catalogue of Paintings in the Central Museum, Lahore*, C-(a)-1: 'Composite Horse'; C-(a)-2: 'Composite Camel'.
173. J. Irwin and K. B. Brett, *Origins of Chintz*, London, 1970, pp. 9, 14, 17, and Pls. 2 and 156.
174. Cf. *Travels of Peter Mundy in Europe and Asia, 1608–67*, iii, pp. 54–5, 63; J. Ovington, *A Voyage to Surat in the Year 1689*, pp. 236–7; J. Burnell, *Bombay in the Days of Queen Anne*, p. 20.
175. W. B. Greenlee, *The Voyage of Pedro Alvares Cabral to Brazil and India*, p. 102.
176. *The Voyage of Francis Pyrard of Laval*, tr. and ed. A. Gray, ii, pt i, pp. 25–6.
177. *Travels of Thévenot and Careri*, tr. and ed. S. N. Sen, p. 192.
178. Tavernier, *Travels in India, 1640–67*, tr. V. Ball, i, p. 69.
179. *Travels of Thévenot and Careri*, p. 169.
180. *The Life of the Icelander Jon Olafsson*, tr. D. B. Phillpotts, ii, p. 147.
181. Burnell, p. 20.

182. H. D. Love, *Vestiges of Old Madras, 1640–1800*, London, 1913, i, p. 215.
183. Tapan Raichaudhury, *Jan Company in Coromandel*, p. 204.
184. Tavernier, i, p. 7.
185. J. Fryer, *A New Account of East India and Persia, being Nine Years' Travels, 1672–81*, ed. W. Crooke, i, p. 214.
186. Ibid.
187. The purchase was made under the name of a Maronite Merchant of Aleppo, called Chelebi (cf. Tavernier, i, p. 7).
188. Pyrard, ii, pt i, p. 63.
189. Ibid., p. 41.
190. Olafsson, ii, p. 147.
191. For the chimney in the English Factory at Hugli, see Burnell, p. 152.
192. Terry in *Early Travels in India*, ed. W. Foster, p. 300.
193. Ovington, pp. 183–4.
194. See above, ch. ii, p. 71.
195. For a 'barrell of wyndowe glasse' brought to Surat in 1618, see *EF*, 1618–21, p. 11.
196. Ibid.
197. Ibid., pp. 11, 141.
198. Ibid., p. 169 (also see pp. 21, 53, 59).
199. Pyrard, ii, pt i, p. 63.
200. Fryer, i, p. 231 (for lattice, p. 192). The mention of Ising-glass is however a mistake on Fryer's part (see p. 231, n. 2).
201. *Travels of Thévenot and Careri*, p. 158.
202. Fryer, i, p. 192.
203. Ibid., p. 172.
204. Ibid., p. 231.
205. For example, the niches (*tāq*) and *hamām* of Shāh Jahān's buildings are reported to have been fitted with *Shisha-hā'i Halabī*, that is, glass from Halab or Aleppo, probably obtained from the Venetians (see 'Abdul Hamīd Lāhorī, *Bādshāhnāma*, Bib. Ind., i, pt i, p. 239). Abul Fazl speaks of the use of glass in windows (*tābdān*), most probably in the royal buildings. He also gives their prices: one pane cost four *dāms* (40 *dāms* = one rupee). According to him, a window required 2½ *ser* of glass (cf. *Ā'īn-i Akbarī*, i, pp. 169, 170–1). The size of the pane is not known.
206. Fryer, i, p. 231.
207. Ovington, p. 130.
208. *Ā'īn*, i, p. 169.
209. Tavernier, i, p. 6.
210. Cf. Abul Fazl, *Akbarnāma*, iii, pp. 146, 228.
211. Badā'ūnī, *Muntakhab-ut Tawārīkh*, Bib. Ind., ii, p. 291. For pictorial depiction of the two European organs, see *Khamsa*, BM Or. 12208, f. 298a: 'Plato Charming the Animals with Music'; Kuhnel and Goetz, Pl. 28 (right corner, below).
212. Cf. C. E. Page, *Musical Instruments*, pp. 48–51.
213. *The Voyage of Thomas Best*, p. 34.
214. *Letters Received by the East India Company from its Servants in the East, 1602–17*, ed. Danvers and Foster, i, p. 282.

215. Cf. H. A. Popley, *The Music of India*, pp. 132, 133, 135. Also Jones and Willard, *Music of India*, p. 32.
216. *Ā'īn*, i, p. 46.

Chapter IV SOCIAL AND CULTURAL RESPONSE

1. A. J. Qaisar, 'The Role of Brokers in Medieval India', *IHR*, no. ii, pp. 230–1.
2. Ibid., p. 231.
2a. Boxer, *The Dutch Seaborne Empire, 1600–1800*, pp. 217, 224.
3. A. K. Priolkar, *Goa Re-discovered*, pp. 64–5.
4. See above, ch. ii, p. 58.
5. Priolkar, *Goa Re-discovered*, p. 63.
6. Ibid.
7. Ibid., p. 64.
8. *The Journal of John Jourdain, 1608–17*, ed. W. Foster, p. 123; also p. 124.
9. *The Voyage of Thomas Best*, ed. W. Foster, p. 105.
10. Ibid., p. 148.
11. J. Fryer, *A New Account of East India and Persia, being Nine Years' Travels, 1672–81*, ed. W. Crooke, i, p. 129.
12. *The Life of the Icelander Jon Olafsson*, tr. D. B. Phillpotts, pp. 138–9.
13. Ibid. For a detailed description of the influence of Portuguese on Indian languages, see J. J. A. Campos, *History of the Portuguese in Bengal*, ch. xvii. Also, A. X. Soares, 'The Portuguese Heritage to the East or the Influence of Portuguese on the Language of the East with Especial Reference to the Language of the Bombay Presidency', *JAS* (Bombay), xxvi, 1921–3, pp. 11–39.
14. Charles Lockyer, *An Account of the Trade in India*, p. 286.
15. Cf. Boxer, *Jan Campagnie in Japan, 1600–1817*, p. 58. Boxer adds that guilds of interpreters had grown up in Japan whose membership was hereditary. Besides, there were official Japanese interpreters too (ibid., pp. 60–1, 63). We do not hear of such guilds in India, nor of official Indian interpreters.
16. J. Ovington, *A Voyage to Surat in the Year 1689*, ed. H. C. Rawlinson, p. 192.
17. J. Burnell, *Bombay in the Days of Queen Anne*, p. 110.
18. Fryer, i. p. 79.
19. Thévenot in *The Indian Travels of Thévenot and Careri*, tr. and ed. S. N. Sen, p. 144.
20. Tapan Raichaudhury, *Jan Company in Coromandel*, p. 206. Also, cf. Boxer, *The Dutch Seaborne Empire*, p. 224.
21. Boxer, *Jan Campagnie in Japan*, p. 12.
22. *Early Travels in India, 1583–1619*, ed. W. Foster, p. 271.
23. J. H. Parry, *The European Reconnaissance*, p. 82.
24. R. P. Rao, *Portuguese Rule in Goa*, pp. 36, 43, 44; K. M. Panikkar, *A History of Kerala*, pp. 158, 159; Manrique, ii, pp. 320–1; E. Maclagan, *The Jesuits and the Great Mogul*, pp. 111–13, 127–8. For an excellent discussion of this topic, see Boxer, *The Portuguese Seaborne Empire*, ch. iii.
25. Panikkar, p. 159.
26. For Āgra, F. S. Manrique, *Travels, 1629–43*, tr. C. E. Luard, ii, pp. 152–3.

27. *The Voyage of Francis Pyrard of Laval*, tr. and ed. A. Gray, ii, pt i, p. 252.
28. Rao, pp. 43, 44.
29. Priolkar, *Goa Re-discovered*, p. 62; Rao, pp. 43, 44.
30. Priolkar, *Goa Re-discovered*, p. 28.
31. Ibid., p. 66. For Panjim, etc., see Rao, p. 65.
32. E. Maclagan, *The Jesuits and the Great Mogul*, pp. 127–8.
33. Burnell, p. 55.
34. Pyrard, ii, pt ii, p. 378.
35. Rao, p. 45. Also Boxer, *The Portuguese Seaborne Empire*, p. 254.
36. Pyrard, p. 39.
37. Ibid., p. 374.
38. Priolkar, *Goa Re-discovered*, p. 67.
39. For reasons for Hindu conversions, see Boxer, *The Portuguese Seaborne Empire*, pp. 81–2.
40. Pyrard, ii, pt i, p. 252.
41. Bernier, *Travels in the Mogul Empire, 1656–68*, tr. A. Constable, p. 291.
42. E. Maclagan, p. 122.
43. B. P. Saksena, *History of Shah Jahan of Dihli*, pp. 104–13.
44. Manucci, *Storia do Mogor, 1653–1708*, tr. W. Irvine, iv, p. 262. Also see Bernier, p. 292.
45. G. R. Crone, *The Discovery of the East*, p. 59; Panikkar, p. 158; Rao, pp. 31, 42; Atul C. Roy, *History of Bengal*, p. 217.
46. Boxer, *Portuguese Society in the Tropics*, pp. 12–13.
47. Campos, *History of the Portuguese in Bengal*, p. 171.
48. Boxer, *The Dutch Seaborne Empire*, p. 229. Also see J. T. Wheeler, *Madras in the Olden Times*, i, pp. 43–4, 46.
49. Boxer, *Race Relations in the Portuguese Colonial Empire*, pp. 58, 65.
50. Pyrard, ii, pt i, pp. 38–9; Boxer, *Race Relations etc.*, p. 62; Crone, p. 59.
51. Fryer, i, p. 171.
52. Pyrard remarked that '. . . Franki signifies all the Western people' (ii, pt ii, p. 243); also Manrique, ii, p. 228.
53. Careri, p. 187.
54. T. Raichaudhury, p. 203.
55. J. Irwin, 'Golconda Cotton Paintings of the Early Seventeenth Century', *Lalit Kala*, no. v, April 1965.
56. Cf. Fryer, i, p. 179.
57. T. Raichaudhury, p. 203.
58. *Travels of Peter Mundy in Europe and Asia, 1608–67*, ii, p. 83 and app. c. (Hawkin's marriage to an Armenian Christian lady is of no value to us (cf. *Early Travels*, p. 85).)
59. D. Kincaid, *British Social Life in India*, pp. 22–3. Also Wheeler, *Madras in the Olden Times*, i, pp. 46–8, 64.
60. Fryer, i, p. 179. Also cf. Boxer, *The Dutch Seaborne Empire*, pp. 220–1.
61. Boxer, *Race Relations etc.*, p. 58.
62. Bernier, p. 437.
63. Thomas Bowrey, *A Geographical Account of Countries Round the Bay of Bengal, 1669 to 1679*, ed. R. C. Temple, p. 195; Thévenot, p. 95; Burnell, pp. 153–4.
64. Bowrey, p. 192.

65. Tavernier, *Travels in India, 1640–67*, tr. V. Ball, i, p. 187.
66. Manrique, ii, pp. 218–19.
67. Ibid., p. 188, for unleavened bread at Lahore.
68. *The Embassy of Sir Thomas Roe to the Great Mogul, 1615–1619*, ed. W. Foster, p. 225.
69. Ovington, p. 230.
70. Campos, pp. 253–8 (Addenda).
71. Asad Beg, 'Memoirs', f. 21a; Sujān Rā'i, p. 454.
72. Asad Beg, f. 21a.
73. Methwold in *Relations of Golconda in the Early Seventeenth Century*, ed. and tr. Moreland, p. 36.
74. Cf. *The Book of Duarte Barbosa, 1500–17*, tr. M. L. Dames, i, pp. 123–4.
75. Cf. Asad Beg, ff. 21a–b.
76. *Tuzuk*, p. 183.
77. Sujān Rā'i, *Khulāsat-ut Tawārīkh*, p. 456.
78. Ibid., p. 455. Sujān Rā'i's own opinion about tobacco alternated between eloquent praise and severe condemnation.
79. *Letters Received*, i, pp. 299–300.
80. Terry in *Early Travels in India*, ed. W. Foster, p. 299.
81. Yūsuf Mīrak, *Mazhar-i Shāh Jahānī*, p. 184.
82. Irfan Habib, *The Agrarian System of Mughal India*, p. 45, n. 76.
83. Fryer, i, p. 266.
84. Tavernier, i, p. 154.
85. Bowrey, p. 107.
86. Tavernier, ii, p. 23.
87. Sujān Rā'i, p. 455. Also see Irfan Habib, *The Agrarian System of Mughal India*, p. 45.
88. Methwold, p. 36; also *EF*, 1618–21, p. 109.
89. *EF*, 1618–21, pp. 64, 92.
90. Terry, p. 299.
91. Asad Beg, f. 21a.
92. Alexander Hamilton, *A New Account of the East Indies*, ed. W. Foster, i, pp. 204–5.
93. Sujān Rā'i, p. 456.
94. Bowrey, p. 97.
95. Fryer, ii, p. 119.
96. *The Travels of Abbé Carré in India and the Near East, 1672–74*, i, p. 227.
97. Thévenot, p. 144.
98. Fryer, i, p. 88.
99. Shāh Nawāz Khān, *Mā'asir-al Umarā'*, i, p. 726.
100. Bowrey, 97.
101. Ibid.
102. See *Bayāz-i Khusbū'ī*, f. 11b.
103. Ibid., f. 12a.
104. Cf. *The Voyage of John Huyghen Van Linschoten to the East Indies*, ii, p. 19; Mundy, ii, pp. 58–9 and n. 5.
105. Abul Fazl, *Ā'īn-i Akbarī*, i, p. 69.
106. *Tuzuk*, pp. 3, 173.

107. J. N. Sarkar, 'A Description of North Bengal in 1609 A.D.', *Bengal, Past and Present*, xxxv, pt ii, April–June 1928, p. 146. For the late seventeenth century, cf. Bernier, p. 438.
108. Irfan Habib, *The Agrarian System of Mughal India*, p. 50.
109. Ibid., p. 50, n. 102.
110. At the end of the sixteenth century, the price of *ananās* was four *dāms* per fruit, while that of wheat was twelve *dāms* per *maund* (cf. *Ā'īn*, i, p. 60).
111. Linschoten, i, p. 27.
112. Thévenot, p. 102; also Irfan Habib, *The Agrarian System of Mughal India*, p. 50.
113. Cf. G. Watts, *A Dictionary of the Economic Products of India*, vi, pt iii, p. 266.
114. Terry, p. 297.
115. Ibid., n. 3. In England, at this time, potato meant either a sweet potato or an ordinary one (cf. *OED*, vii, pp. 184–5).
116. See ch. iii above.
117. See ch. ii above.
118. Manrique, ii, pp. 218–19.
119. Cf. Irfan Habib, *The Agrarian System of Mughal India*, p. 45, n. 89.
120. Barbosa, i, pp. 123–4.
121. Fryer, i, p. 263.
122. *EF*, 1622–3, p. 191.
123. Methwold cited in Irfan Habib, *The Agrarian System of Mughal India*, p. 48, n. 88.
124. Fryer, ii, p. 76.
125. Panikkar, pp. 179–80.
126. Cf. P. K. Gode, *Studies in Indian Cultural History*, i, pp. 439–54.
127. Cited in V. Slomann, *Bizarre Designs in Silks*, p. 96.
128. Farewell's account in the *Voyage of Downton*, p. 150.
129. *EF*, 1642–5, p. 57.
130. Mundy, ii, p. 358.
131. Thévenot, p. 52; also see Burnell, p. 95.
132. Ovington, p. 185.
133. Bernier, p. 240.
134. For wigs having reached India, see Tavernier, i, p. 12.
135. *Tuzuk*, p. 115.
136. Cf. N. N. Raye, *The Annals of the Early English Settlement in Bihar*, p. 55.
137. Slomann, p. 96.
138. Mundy, ii, p. 218.
139. Mundy, iii, pp. 62–3.
140. Ibid., p. 63.
141. Careri, p. 247.
142. Mundy, iii, p. 84.
143. Manrique, ii, p. 215.
144. *Purchas His Pilgrimes*, pp. 532–3.
145. Ibid., ii, p. 314.
146. *The Travels of Pedro Teixeira*, tr. and ed. W. F. Sinclair and D. Ferguson, p. 53.
147. Mundy, ii, p. 218.
148. Ovington, p. 233. For indoor European dining manners with chairs, table,

napkin, spoons and knives at Chinapatan on the Coromandel coast, see *The Ship of Sulaiman*, tr. J. O'Kane, pp. 34, 35.

149. Roe, p. 65.
150. In Persia too chairs were meant for ceremonial purposes, as a kind of throne (cf. Pope and Ackerman, *A Survey of Persian Art*, vi, p. 2629).
151. Fryer, ii, p. 120; also, i, p. 88.
152. Bowrey, p. 96.
153. *Purchas*, ii, p. 320.
154. Fryer, i, p. 88.
155. Ibid., ii, p. 121.
156. Ibid., i, p. 94.
157. Ibid., p. 335. Pyrard wrote that the Portuguese in India never slept without calsons and pyjamas as nightwear (cited in Slomann, p. 97).

Chapter V EPILOGUE

1. See A. J. Qaisar, 'The Role of Brokers in Medieval India', *IHR*, vol. i, no. ii, 1974, pp. 240–6.
2. Cf. Irfan Habib, 'Potentialities of Capitalistic Development in the Economy of Mughal India', *Enquiry*, New Series, iii, no. 3, 1971, p. 49. Also see B. G. Gokhale, 'Capital Accumulation in xviith-Century Western India', *JAS* (Bombay), xxxviii–xl, 1963–5, pp. 56–7.
3. A. J. Qaisar, 'Merchant Shipping in India during the Seventeenth Century', *Medieval India—A Miscellany*, ii, p. 214, n. 1.
4. Cf. Otto Kurz, *European Clocks and Watches in the Near East*, pp. 62, 63.
5. Ibid., pp. 47–9, 50, 54, 74–5, 83–4.
6. See Jonathan D. Spence, *Emperor of China: Self-portrait of K'ang-hsi*, p. 68.
7. Cf. T. F. Carter, *The Invention of Printing in China*, ch. xv; also see Irfan Habib, 'The Technology and Economy of Mughal India', The Dev Raj Chanana Lectures, Delhi, 1970 (cyclostyled), p. 40.
8. Carter, pp. 152–3, 172–3.
9. Ibid., pp. 170–1.
10. Ibid., ch. xviii.
11. Ibid., p. 150.
12. Ibid.
13. Ibid., p. 179
14. Ibid., pp. 150–1.
15. Carlo M. Cipolla, *The Fontana Economic History of Europe*, ii, pp. 192, 216–17, 218.
16. W. A. Lewis, *The Theory of Economic Growth*, p. 178.
17. Cf. Irfan Habib, 'Technological Changes and Society: 13th and 14th Centuries', *PIHC*, 31st Session, Varanasi, 1969.
18. For a significant contribution, see Morris D. Morris, 'Values as an Obstacle to Economic Growth in South Asia: A Historical Survey', *JEH*, xxvii, 1967, pp. 588–607.
19. Cf. Irfan Habib, 'Potentialities etc', pp. 39–41; also nn. 20–3.

Appendix C ADDITIONAL NOTES ON TECHNOLOGY

1. M. A. Alvi and A. Rahman, *Fathullah Shirazi—A Sixteenth-Century Indian Scientist*, pp. 10, 13.
2. Thévenot in *The Indian Travels of Thévenot and Careri*, tr. and ed. S. N. Sen, p. 66.
3. For screwed pistols coming to India, see I.O., *Surat*, G/36/8, 9 Sept. 1703, p. 880. Also see ch. ii above, p. 54.
4. Cf. A. U. Pope and P. Ackerman, *A Survey of Persian Art: From Prehistoric Times to the Present*, vi, p. 2584.
5. E. B. Sainsbury (ed.), *A Calendar of Court Minutes of the East India Company, 1674–76*, p. 344.
6. J. Ovington, *A Voyage to Surat in the Year 1689*, ed. H. C. Rawlinson, p. 133. For an Indian saw, see J. Marek *et al.*, *The Chengiz Khan Miniatures from the Court of Akbar the Great*, Pl. 29. For the earliest pictorial depiction of an Indian saw, see Muhammad Shādiyābādī, *Miftāh-ul fuzalā'*, BM Or. 3299, f. 62a. Also see V & A, Clive Album, f. 80(a): 'Martyrdom of Prophet Zakariyā' (Mughal, *c.* 1605–10).
7. *The Life of the Icelander Jon Olafsson*, tr. D. B. Phillpotts, pp. 142–3. For a pictorial depiction of bellows, see Nūruddīn 'Obaidur Rahmān Jāmī, *Nafāhat-ul uns min Hazrāt-ul quds*, BM Or. 1362, f. 39b: 'Iron-monger Turns a Saint'.
8. Tavernier, *Travels in India, 1640–67*, tr. V. Ball, i, p. 230.

8a. Sāqī Must'ad Khān, *Mā'asir 'Ālamgīrī*, Bib. Indica, p. 279.

8b. Ānand Rām Mukhlis, *Mir'āt-al istilāh*, BM Or. 1813, s.v. *tūtiyā'i qalam*.

9. Ovington, p. 151.
10. *Bāburnāma*, tr. Beveridge, p. 536.
11. Thévenot, p. 62.
12. J. Burnell, *Bombay in the Days of Queen Anne*, pp. 150–1. Also see W. Irvine, *The Army of the Indian Moghuls*, p. 114–15.
13. Arnold Wright, *Early English Adventurers in the East*, pp. 166–7. Also see *A Supplementary Calendar of Documents in the India Office Relating to India or to the Home Affairs of the East India Company, 1600–1640*, ed. Foster, p. 113.
14. I.O., *Surat*, G/36/8, 4 Nov. 1703, p. 954.

Appendix E CARTOGRAPHY

1. See *The Commentary of Father Monserrate*, tr. J. S. Hoyland and annotated by S. N. Banerjee, p. 126.
2. *The Embassy of Sir Thomas Roe to the Great Mogul, 1615–1619*, ed. W. Foster, pp. 413–14, 416–17. This Atlas was published in 1612 at Amsterdam by Hondius (4th ed.) called *Gerardi Mercatoros Atlas denus auctus* (cf. ibid., p. 542 ff., note on the map).
3. Pelsaert, 'Remonstrantie', tr. W. H. Moreland and P. Geyl as *Jahangir's India*, p. 26.

4. Irfan Habib, 'Cartography in Mughal India', *Medieval India—A Miscellany*, iv, pp. 122–34.
5. Cf. J. Needham, *Science and Civilization in China*, iii, p. 549. Also see al-Idrīsī's world-map where south is at the top (ibid., fig. 239).
6. Cf. Bernier, *Travels in the Mogul Empire*, ed. A. Constable.

Appendix F LANTERN

1. Cf. *EF*, 1668–9, p. 160.
2. *The Voyage of Francis Pyrard of Laval*, tr. and ed. A. Gray, ii, pt i, p. 63.
3. See L. Hajek, *Indian Miniatures of the Moghul School*, Pl. 6: 'The Burglar's Escape from the Palace'; D. Barrett and Basil Gray, *Painting of India*, p. 94: 'A Female Demon Interviews a King at Night'; Percy Brown, *Indian Painting under the Mughals*, Pl. xxxiv: 'Prayer at Night'; *Akbarnāma*, i, BM 12988, f. 128r: 'Musāhib Beg Surrenders before Humāyūn'.
4. See Y. A. Godard and B. Gray, *Iran—Persian Miniatures*, Pl. xxiii: 'An Outdoor Night Scene' (first half of the sixteenth century).
5. Cf. Arnold and Wilkinson, *The Library of Chester Beatty etc.*, ii, Pl. 36: 'Rudolph Acquaviva and Another Jesuit Debating with Muslim Divines before Akbar'; P. Brown, Pl. li: 'Night Scene: Darweshes'; *Akbarnāma*, i, V & A, 93/117: 'Akbar's Inspection after the Chase'; Michael Goedhuis, *Indian Painting*, Pl. 36: 'Night Celebrations at the Wedding of Prince Dārā Shukoh'.
6. Cf. S. C. Welch, *The Art of Mughal India*, Pl. 24: 'A Thief Bound to a Column' (from *Būstān* of Sa'dī, Fogg Art Museum, Mughal, *c.* 1605). I owe this reference to my friend and colleague, S. P. Verma.

Appendix G EUROPEAN CONTRIBUTIONS TO THE FAUNA OF INDIA

1. Abul Fazl, *Ā'īn-i Akbarī*, ii (*Ā'īn* no. 28).
2. Memorandum of Downton in *The Voyage of Downton*, p. 187; also *Letters Received*, ii, p. 173.
3. *The Embassy of Sir Thomas Roe to the Great Mogul, 1615–1619*, ed. W. Foster, i, p. 388.
4. *Ā'īn*, ii (*Ā'īn* no. 28).
5. Ibid.
6. Ibid.
7. *Tuzuk-i Jahāngīrī*, p. 58.
8. Ibid., p. 142.
9. Ibid., p. 143.
10. Ibid., p. 327.
11. Hawkins in *Early Travels in India*, ed. W. Foster, p. 104.
12. *EF*, 1631–41, p. 183. For English mastiffs in Persia, see Fryer, ii, p. 305.
13. Dodsworth in *The Voyage of Downton*, p. 104.
14. Fryer, *A New Account of East India etc.*, ed. W. Crooke, i, p. 280.
15. W. Foster, *John Company*, p. 92.

16. Manucci, *Storia do Mogor, 1653–1708*, ed. H. C. Rawlinson, iv, pp. 254–6. Dā'ūd Khān kept tigers, leopards, hawks, ducks (one thousand in number) besides many other birds on which he spent every year two hundred and fifty thousand rupees.
17. Terry, *Early Travels in India*, ed. Foster, p. 312.
18. Ibid.
19. J. Ovington, *A Voyage to Surat in the Year 1689*, p. 161.
20. Ibid., p. 160.
21. Edwards in *The Voyage of Downton*, p. 172.
22. Ovington, p. 160.
23. *Tuzuk*, pp. 104–5. Saiyid Ahmad Khan, who edited the Persian text of Jahāngīr's memoirs, is of the opinion that the bird described is the turkey, which in Persian is called *fīlmurgh*, and in India *Piru* (ibid., p. 105 n.). Also see Alvi and Rahman, *Jahāngīr—The Naturalist*, pp. 63–4 and Pl. xii. Cf. S. Clarke, *Indian Drawings, Thirty Mughal Paintings of the School of Jahāngīr*, p. 15 (no. 23).
24. *Travels of Peter Mundy in Europe and Asia, 1608–67*, iii, p. 62.
25. Mundy, p. 62, n. 3.
26. Ibid., ii, p. 318.
27. Ibid., iii, pt ii, pp. 352–3. See Sálim Ali's note on the Dodo in M. A. Alvi and A. Rahman, *Jahāngīr—The Naturalist*, pp. 14–17 (also see Pl. ii in Alvi and Rahman).

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PAINTINGS

The following list consists of the original paintings (referred to in the present work) studied by us, and their sources, that is, unpublished manuscripts, separate miniatures and prints.

I. BRITISH MUSEUM

(A) *Department of Printed Books and Manuscripts*

(a) *Akbarnāma*, vol. i, Or. 12988 (Akbar's period):
folio 34b: 'Birth of Timūr' (by Rāmdās Gujarātī).
folio 66a: 'Bahādur Shāh of Gujarāt Being Drowned in a Battle with the Portuguese' (by Lāl).

(b) *Dārābnāma*, Or. 4615 (Akbar's period):
folio 31a: 'A Scene Showing Boat, etc.' (by Jaggan).
folio 34a: '[Title as above]' (by Basāwan).
folio 55a: '[Title as above]' (by Chitra Bhoj).
folio 76b: '[Title as above]' (by Mukhlis).

(c) *Razmnāma*, Or. 12076 (Akbar's period):
folio 7b: 'A Battle Scene' (by Nārayan *khurd*).
folio 35b: 'A Battle Scene' (by Āās, son of Mahesh).

(d) *Shāhnāma*, Add. 5600 (Akbar's period):
folio 372a: 'Building Activities' (by Qāsim).

(e) *Khamsa* of Nizāmī, Or. 12208 (Akbar's period):
folio 206a: 'Maid with a Round Mirror'.
folio 298a: 'Plato Charming Animals with Music' (by Mādhav *khānāzād*).

(f) *Jawāhir-al Musīqāt-i Muhammadī*, Or. 12857 (A.D. 1625–55):
folio 92a: 'Lady with a Round Mirror' (*Bhopal Ragini*).

(g) *Dīwān* of Hāfiz, Add. 7763 (Kashmīr, 18th century):
folio 16b: 'Lady with a Rectangular Mirror'.

(h) *Miftāh-ul fuzalā'*, Or. 3299 (A.D. 1469):
folio 62a: 'A Sawyer'.
folio 161b: 'Pearl-boring with a Bow-drill'.

(i) *Nafahāt-ul uns min Hazrāt-ul Quds*, Or. 1362 (A.D. 1603–4):
folio 39b: 'Iron-monger Turns a Saint'.

(B) *Department of Oriental Antiquity*

1920 9–17 01: 'Royal Hawking Party on a Lake' (Jahāngīr's period).
1920 9–17 013(21): 'Mary Worshipped by Angels—Annunciation?' (17th century).
1920 9–17 032: 'Christ Stilling the Storm' (*c.* 1650).
1920 9–17 036: 'Presentation to the Temple' (17th century).
1920 9–17 0241: 'Man and Woman Drinking Together' (*c.* 1590).
1920 9–17 0276(B): 'Descent from the Cross' (17th century).
1928 8–15 05: 'Four European Ladies Feasting by the Bank of a River' (17th century).
1929 6–11 010: 'European Lady with a Glass and a Basket of Flowers' (late 17th century).
1936 6–13 01: 'A European Couple in a Garden' (Jahāngīr's period).
1942 1–24 02: 'Madonna Feeding Infant Jesus' (early Jahāngīr).
1942 1–24 03: 'A Wooded Landscape' (*c.* 1625).
1954 5–8 02: 'A Caprice: Portrait of Francis Dauphin of France' (late 17th century).
1956 7–14 024: 'A Frenchman' (early 18th century).
1956 7–14 026: 'French Ladies in a Garden' (early 18th century).
1956 7–14 028: 'Woman in European Dress Feeding Pet Birds' (early 18th century).
1965 7–24 05: 'Christ's Entry into Jerusalem' (*c.* 1610).
1974 6–17 021(50): 'A Hunting Scene' (late 17th century).

2. INDIA OFFICE LIBRARY AND RECORDS

(A) *Johnson Collection*

6–6: 'A Christian Scene Based on the Last Supper' (*c.* 1700).
14–2: 'Mary with a Rose and Infant Jesus' (Jahāngīr's period).
14–3: 'Presentation to the Temple' (*c.* 1610 ?).
14–5a: 'A Kneeling Saint at His Prayers' (early 17th Century).
14–6: 'Magdalen [?] Praying' (mid-17th century).
14–7: 'A European Lady Feeding Her Dog' (*c.* 1650).
14–9: 'Virgin [and Child] Standing on a Crescent Moon Entwined with a Serpent' (*c.* 1620–30).
14–10: 'A Crowned Virgin Standing on a Crescent Moon Entwined with a Serpent' (17th century).
16–1: 'The Good Shepherd' (by Mishkin, *c.* 1600).
16–6: 'A European Reading a Book with Attendants Around' (*c.* 1600).
16–8: 'A European Holding a Wine Cup and a Bottle, Accompanied by His Dog' (second half of the 17th century).
22–2: 'Lord Edmond, Earl of Malgrave etc.' (17th century).

(B) *Dārā Shukoh Album*

folio 42 verso: 'Mary and Jesus under a Tree'.
folio 43 recto: 'Two Original Engravings'.
folio 74 recto: 'A European Couple'.

(C) *Drawings of Thomas Daniell—'Views of Calcutta'* (1780s)

Pl 2: 'Old Court House and Writers' Building, 1786'
Pl. 12: 'St. John's Church, 1788'.

3. VICTORIA AND ALBERT MUSEUM

(A) *Illustrations to Akbarnāma*, vol. i (IS 2–1896)

No. 2/117: 'Wild Cheetah Being Captured by Akbar in a Trap-door Pit' (by Tulsī and Nārayan).
No. 3/177: 'Akbar Going to Agra by Boat' (by Tulsī and Nārayan).
No. 15/117: 'Adham Khān Doing Homage at Sārangpūr' (by Khemkaran).
No. 24/117: 'Akbar Hunting in the Neighbourhood of Āgra' (by Basāwan and Dharamdās).
No. 74/117: 'Akbar's Forces Besiege Ranthambhor' (by Mishkin and Bhūrah).
No. 80/117: 'Birth of Prince Murād' (by Bhūrah and Basāwan).
No. 93/117: 'Akbar's Torchlight Inspection after the Chase' (by Lāl and Kesū *khurd*).

(B) *Separate Miniatures and Prints*

IM 7–1913: 'Lady with Companion, Based on an Annunciation Scene in a European Engraving'.
IM 8–1913: 'Portrait of a Lady in European [Elizabethan] Dress Described Lady Shirley'.
IM 9–1913: 'A European' (17th century).
IM 284–1913: 'St. Catharine of Alexandria with Preceptors [?]' (*c.* 1600).
IM 293–1913: 'Two European Ladies Walking in a Landscape' (*c.* 1610).
IM 139–1921: 'Martyrdom of St. Cecilia, after an Engraving by Hieronymus Wierix of Antwerp' (by Nīnī).
IS 170–1950: 'Cleaning of the Inn at Bethlehem, from *Dāstān-i Masīh*' (by Mas'ūd Deccani).
IS 133(79)–1964: 'Descent from the Cross' (17th century).
IS 218–1952: 'A European Doctor of Law Facing a Storm in a Landscape'.
D. 132–1885(25): 'The Parable of the Bad Seeds' (Aurangzeb's period?).

D. 132–1885(28): 'The Revival of the Daughter of Jarius, and the Curing of a Woman from Bleeding' (Aurangzeb's period ?).
D. 132–1885(30): 'Virgin and Child with Simon'.
D. 399–1885: 'A European Drinking Party' (17th century).
D. 402–1885: 'Nativity in the Manger and the Magi' (17th century).

(C) *The Clive Album*

folio 7b: 'Sarah, Wife of Abraham' (early 17th century).
folio 8a: 'The Widow's Son Raised from the Dead' (17th century).
folio 10a: 'Summer' (17th century).
folio 11b: 'Autumn' (17th century).
folio 12a: 'Winter' (17th century).
folio 14a: 'Christ in the Wilderness' (early 17th century).
folio 80a: 'Martyrdom of Prophet Zakariyā' (Mughal, A.D. 1605–10).

(D) *The Small Clive Album*

folio 2a: 'Four Tinted Mughal Drawings Based on European Engravings' (late 17th or early 18th century).

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